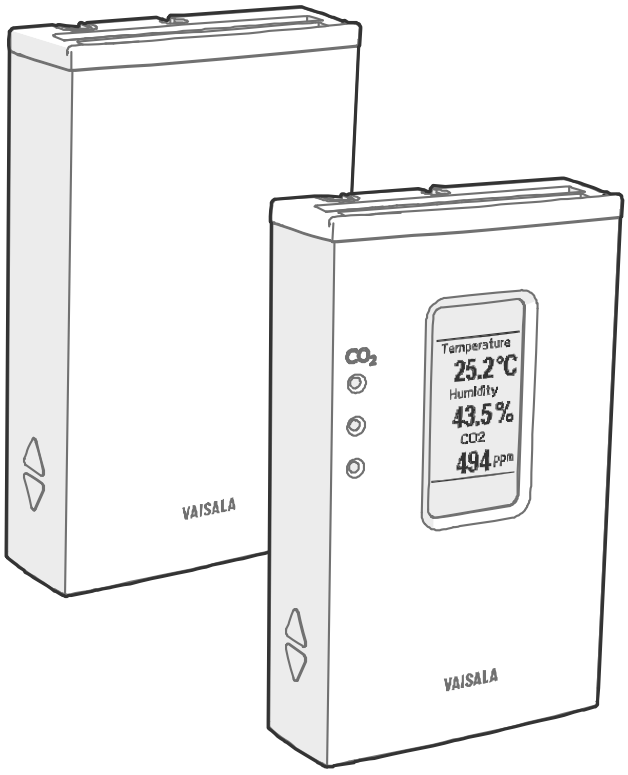
VAISALA

USER'S GUIDE

Vaisala CARBOCAP® Carbon Dioxide, Temperature, and Humidity Transmitters GMW90 Series



M211659EN-A

PUBLISHED BY

Vaisala Oyj
P.O. Box 26
FI-00421 Helsinki
Finland

Phone (int.): +358 9 8949 1
Fax: +358 9 8949 2227

Visit our Internet pages at www.vaisala.com.

© Vaisala 2013

No part of this manual may be reproduced, published or publicly displayed in any form or by any means, electronic or mechanical (including photocopying), nor may its contents be modified, translated, adapted, sold or disclosed to a third party without prior written permission of the copyright holder. Translated manuals and translated portions of multilingual documents are based on the original English versions. In ambiguous cases, the English versions are applicable, not the translations.

The contents of this manual are subject to change without prior notice.

This manual does not create any legally binding obligations for Vaisala towards customers or end users. All legally binding obligations and agreements are included exclusively in the applicable supply contract or the General Conditions of Sale and General Conditions of Service of Vaisala.

Table of Contents

CHAPTER 1

GENERAL INFORMATION **7**

About This Manual **7**

Contents of This Manual 7

Version Information 8

Related Manuals 8

Documentation Conventions 8

Safety **9**

ESD Protection 9

Recycling **10**

Regulatory Compliances **10**

Patent Notice **10**

Trademarks **11**

Software License **11**

Warranty **11**

CHAPTER 2

PRODUCT OVERVIEW **13**

Introduction to GMW90 Series **13**

GMW90 Series Transmitters **14**

Output Parameters Explained **15**

Transmitter parts **16**

Decorative Cover Option **19**

CHAPTER 3

INSTALLATION **21**

Configuration Before Installation **21**

Configuration of Digital Output Models 21

DIP Switches of Digital Output Models 22

Addressing with BACnet Protocol 23

Addressing with Modbus Protocol 23

Selecting Location **24**

Installing the Mounting Base **25**

Wiring **25**

Wiring GMW95 27

Connecting Several Transmitters on Same RS-485 Line 27

Connecting a Common AC Power Supply to Several Transmitters 28

CHAPTER 4

OPERATION **29**

Display **29**

Startup Screens 29

Measurement Screen 30
Indicators on the Display 31
Service Port 31
Connecting With an MI70 Indicator 31
Connecting With a PC 32
Installing the Driver for the USB Service Cable 32
Terminal Application Settings 33
List of Serial Commands 35
Transmitter Information 36
Show Transmitter Information 36
Show Transmitter Firmware Version 36
Show Transmitter Serial Number 36
Show Transmitter Status 37
Show Measured Parameters 39
Show Command Help 39
Show Command List 40
Measurement Settings 40
Set Environmental Parameters 40
Display Settings 41
Select Parameters to Display 41
Serial Line Output Commands 42
Start Measurement Output 42
Stop Measurement Output 42
Output a Reading Once 42
Set Output Interval 43
Set Output Format 44
Serial Line Settings 46
Set Remote Echo 46
Set Serial Line Turnaround Delay 46
Calibration and Adjustment Commands 47
Adjust CO_2 Measurement 47
Show Current CO_2 Adjustment 47
1-point Adjustment of CO_2 Measurement 48
2-point Adjustment of CO_2 Measurement 48
Clear User Adjustment of CO_2 Measurement 49
Adjust Humidity Measurement 49
Show Current RH Adjustment 49
1-point Adjustment of RH Measurement 50
2-point Adjustment of RH Measurement 50
Clear User Adjustment of RH Measurement 51
Adjust Temperature Measurement 51
Show Current T Adjustment 51
1-point Adjustment of T Measurement 51
Clear User Adjustment of T Measurement 52
Enter Calibration and Adjustment Information 52
Other Commands 52
Enable Advanced Serial Commands 52
Reset Transmitter 53
Set BACnet Parameters 53

CHAPTER 5
MAINTENANCE 55
Cleaning 55
Calibration and Adjustment 55

Adjustment Methods 55
Notes for CO_2 Adjustment 56
Using Calibration Gas vs. Ambient Gas 56
Effect of Temperature on CO_2 Measurement 56
Effect of Pressure on CO_2 Measurement 57
Notes for T Adjustment 57
Notes for RH Adjustment 57
Adjustment Using Display and Trimmers 58
Adjustment Using a Hand-Held Meter 59
Adjustment Using a PC 60
Repair Maintenance 61
Replacing the GM10 Module 62
Replacing the HTM10 Module 63

CHAPTER 6
TROUBLESHOOTING 65
Problem Situations 65
Error Messages 66
Viewing Error Messages on Serial Line 67
View Currently Active Errors 67
View Error Table 67
Reverting to Factory Settings 68
Reverting to Factory Settings Using DIP Switches 68
Reverting to Factory Settings Using Service Port 69
Technical Support 69
Product Returns 69

CHAPTER 7
TECHNICAL DATA 71
Specifications 71
Spare Parts and Accessories 73
Dimensions in mm 74

APPENDIX A
BACNET REFERENCE 75
BACnet Protocol Implementation Conformance Statement 75
Transmitter Models and Objects 77
Device Object 78
Carbon Dioxide Object 80
Temperature Object 81
Relative Humidity Object 82
Calculated Humidity Objects 83
Operation Pressure Object 84
Operation Altitude Object 85
BIBBs Supported 86
Application Services Supported 87

APPENDIX B
MODBUS REFERENCE 89

List of Figures

Figure 1 GMW90 with Visible Display and Indicator LEDs 13
Figure 2 Transmitter Parts - Outside 16
Figure 3 Opening the Transmitter 17
Figure 4 Transmitter Parts – Inside 18
Figure 5 Decorative Cover 19
Figure 6 DIP Switch Settings of Digital Output Models 22
Figure 7 Example of Transmitter Addressing 23
Figure 8 Selecting Transmitter Location 24
Figure 9 Installing the Mounting Base 25
Figure 10 Wiring from Behind (Recommended) 26
Figure 11 Wiring from Above 26
Figure 12 Wiring GMW95 27
Figure 13 Several Transmitters on Same RS-485 Line 27
Figure 14 Connecting a Common AC Power Supply 28
Figure 15 GMW95 Startup Screens 29
Figure 16 Measurement Screen – Normal Operation 30
Figure 17 Measurement Screen – Problem With Humidity Measurement 30
Figure 18 PuTTY Terminal Application 34
Figure 19 Effect of Pressure on CO2 Reading 57
Figure 20 Trimmer Centering Screen 58
Figure 21 Adjustment Screen 58
Figure 22 Disconnecting the GM10 Module 62
Figure 23 Replacing the HTM10 Module 63
Figure 24 DIP Switches in Factory Reset Position 68
Figure 25 GMW90 Series Dimensions 74
Figure 26 Dimensions of the Mounting Base 74

List of Tables

Table 1	Manual Revisions	8
Table 2	Related Manuals	8
Table 3	Applicable Patents	10
Table 4	GMW90 Series Transmitters	14
Table 5	Parameters Supported by GMW90 Series	15
Table 6	Serial Interface Settings	33
Table 7	Basic Serial Commands	35
Table 8	Advanced Serial Commands	35
Table 9	FORM Command Parameters	45
Table 10	FORM Command Modifiers	45
Table 11	Troubleshooting Table	65
Table 12	Error Messages	66
Table 13	Performance	71
Table 14	Operating Environment	72
Table 15	Inputs and Outputs	72
Table 16	Mechanics	72
Table 17	GMW90 Series Spare Parts and Accessories	73
Table 18	Device Object Properties	78
Table 19	Carbon Dioxide Object Properties	80
Table 20	Status Flags	80
Table 21	Reliability	80
Table 22	Event State	80
Table 23	Temperature Object Properties	81
Table 24	Status Flags	81
Table 25	Reliability	81
Table 26	Event State	81
Table 27	Relative Humidity Object Properties	82
Table 28	Status Flags	82
Table 29	Reliability	82
Table 30	Event State	82
Table 31	Calculated Humidity Objects	83
Table 32	Calculated Humidity Object Properties	83
Table 33	Status Flags	83
Table 34	Reliability	84
Table 35	Event State	84
Table 36	Operation Pressure Object Properties	84
Table 37	Status Flags	84
Table 38	Operation Altitude Object Parameters	85
Table 39	Status Flags	85
Table 40	BACnet Smart Sensor BIBBs Support	86
Table 41	BACnet Standard Application Services Support	87
Table 42	Modbus Functions Supported by GMW90	89
Table 43	GMW90 Modbus Measurement Data Registers	89
Table 44	GMW90 Modbus Status Registers (Read-only)	90
Table 45	GMW90 Modbus Error Code Bits	90
Table 46	GMW90 Modbus Configuration Parameter Registers	90
Table 47	GMW90 Modbus Device Identification	90
Table 48	GMW90 Modbus Exception Responses	90

This page intentionally left blank.

CHAPTER 1

GENERAL INFORMATION

This chapter provides general notes for the manual and the products that are covered.

About This Manual

This manual provides information for installing, operating, and maintaining GMW90 series transmitters. All transmitter models in the series are covered, which means that some information in the manual is model-specific.

Contents of This Manual

This manual consists of the following chapters:

- Chapter 1, General Information, provides general notes for the manual and the products that are covered.
- Chapter 2, Product Overview, introduces the GMW90 series transmitters.
- Chapter 3, Installation, provides you with information that is intended to help you install the GMW90 series transmitters.
- Chapter 4, Operation, contains information that is needed to operate the GMW90 series transmitters.
- Chapter 5, Maintenance, provides information that is needed in basic maintenance of the GMW90 series.
- Chapter 6, Troubleshooting, describes possible problems, their probable causes and remedies, and provides contact information for technical support.
- Chapter 7, Technical Data, provides the technical data of the GMW90 series transmitters.
- Appendix A, BACnet Reference,describes the BACnet protocol implementation of the GMW90 series digital transmitters.
- Appendix B, Modbus Reference, describes the Modbus protocol implementation of the GMW90 series digital transmitters.

Version Information

Table 1 Manual Revisions

Manual Code	Description
M211659EN-A	November 2013. This manual. First version.

Related Manuals

Table 2 Related Manuals

Manual Code	Manual Name
M211511EN	HMW90 and GMW90 Series Quick Guide for Digital Output models
M211476EN	Decorative Cover Quick Guide
M211606EN	Decorative Cover Printable Insert

Documentation Conventions

Throughout the manual, important safety considerations are highlighted as follows:

WARNING Warning alerts you to a serious hazard. If you do not read and follow instructions very carefully at this point, there is a risk of injury or even death.

CAUTION Caution warns you of a potential hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.

NOTE Note highlights important information on using the product.

Safety

The transmitter delivered to you has been tested and approved as shipped from the factory. Note the following precautions:

WARNING	Connect only de-energized wires.

CAUTION	If you connect more than one transmitter to a single 24 VAC transformer, always connect the phase (~) to the +Vs connector in each transmitter.

CAUTION	The trimmers only turn 135 degrees each way, less than half a rotation. Do not force the trimmer past the stopping point.

CAUTION	Do not modify the unit. Improper modification can damage the product or lead to malfunction.

ESD Protection

Electrostatic Discharge (ESD) can cause immediate or latent damage to electronic circuits. Vaisala products are adequately protected against ESD for their intended use. It is possible to damage the product, however, by delivering electrostatic discharges when touching, removing, or inserting any objects inside the equipment housing.

To make sure you are not delivering high static voltages yourself:

- When installing the transmitter, do not touch exposed contacts on the component board.
- Handle ESD sensitive components on a properly grounded and protected ESD workbench.
- Always hold component boards by the edges and avoid touching the component contacts.

Recycling

Recycle all applicable material.

Dispose of the unit according to statutory regulations.
Do not dispose of with regular household refuse.

Regulatory Compliances

GMW90 series transmitters comply with the following performance and environmental test standards:

- EMC-Directive

Conformity is shown by compliance with the following standards:

- EN 61326-1: Electrical equipment for measurement, control, and laboratory use – EMC requirements – for use in industrial locations.
- EN 550022: Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.

Patent Notice

GMW90 series are protected by the following patents and their corresponding national rights:

Table 3 Applicable Patents

Patent Issued By	Patent Number
United States Patent and Trademark Office	US 5,827,438
	US 6,177,673
European Patent Office	EP0776023
	EP0922972
German Patent and Trade Mark Office	69615635
Japan Patent Office	4263285
Finnish Patent Office	112005
	105598

Trademarks

CARBOCAP® is a registered trademark of Vaisala Oyj.

All other trademarks are the property of their respective owners.

Software License

This product contains software developed by Vaisala. Use of the software is governed by license terms and conditions included in the applicable supply contract or, in the absence of separate license terms and conditions, by the General License Conditions of Vaisala Group.

Warranty

Visit our Internet pages for standard warranty terms and conditions: www.vaisala.com/warranty.

Please observe that any such warranty may not be valid in case of damage due to normal wear and tear, exceptional operating conditions, negligent handling or installation, or unauthorized modifications. Please see the applicable supply contract or Conditions of Sale for details of the warranty for each product.

This page intentionally left blank.

CHAPTER 2

PRODUCT OVERVIEW

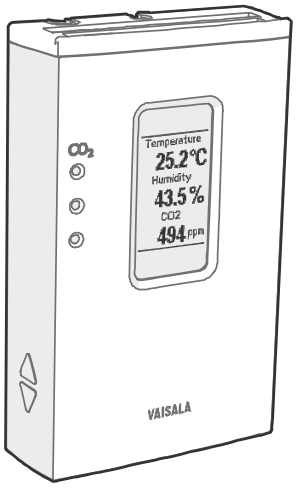
This chapter introduces the GMW90 series transmitters.

Introduction to GMW90 Series

GMW90 series transmitters are wall-mount transmitters for building automation applications. GMW90 series transmitters measure carbon dioxide (CO_2) and temperature (T), with the option for humidity measurements. The CO_2 measurement is based on a new generation CARBOCAP® sensor, which uses a novel, silicon-based microchip emitter instead of an incandescent light bulb.

All transmitter models in the series share the following common features:

- Detachable mounting base for easy installation and wiring.
- Display (visible or hidden behind the cover).
- Sliding cover for accessing maintenance functions.
- Adjustment trimmers.
- DIP switches for most common configuration tasks.
- RS-485 line for temporary service use with hand-held MI70 indicator or PC.



1310-036

Figure 1 GMW90 with Visible Display and Indicator LEDs

GMW90 Series Transmitters

Table 4 below lists the most important differences between the GMW90 series transmitter models. For technical specifications, see Chapter 7, Technical Data, on page 71.

Table 4 GMW90 Series Transmitters

Product Code	Short Description
GMW95	Carbon dioxide and temperature transmitter with - digital output (isolated RS-485) - BACnet MS/TP or Modbus protocol (DIP switch setting) - display hidden under sliding cover
GMW95D	Carbon dioxide and temperature transmitter with - digital output (isolated RS-485) - BACnet MS/TP or Modbus protocol (DIP switch setting) - visible display
GMW95R	Carbon dioxide, humidity and temperature transmitter with - digital output (isolated RS-485) - BACnet MS/TP or Modbus protocol (DIP switch setting) - display hidden under sliding cover
GMW95RD	Carbon dioxide, humidity and temperature transmitter with - digital output (isolated RS-485) - BACnet MS/TP or Modbus protocol (DIP switch setting) - visible display
GMW90	GMW90 series wall-mount transmitter that has been customized at Vaisala. Check type label on transmitter body and terminal label on the mounting base.

Output Parameters Explained

Table 5 Parameters Supported by GMW90 Series

Parameter	Symbol	Unit(s)	Description
Carbon dioxide	CO2	ppm	Concentration of carbon dioxide gas.
Temperature	T	°C °F	Temperature in Celsius or Fahrenheit scale.
Relative humidity	RH	%	Ratio of the partial pressure of water vapor in the air to the saturation vapor pressure of air at the current temperature.
Dewpoint	Td	°C °F	Temperature at which the water vapor in the air will condense into water at the current pressure.
Dewpoint	Tdf	°C °F	Same as Td, except when the dewpoint is below 0 °C, the transmitter outputs frostpoint (Tf) instead of dewpoint.
Dewpoint depression	dTd	°C °F	Difference between ambient temperature and dewpoint (Tdf).
Wet bulb temperature	Tw	°C °F	The minimum temperature that can be reached by evaporative cooling in the current conditions.
Absolute humidity	a	g/m3 gr/ft3	Quantity of water in a cubic meter (or cubic foot) of air.
Mixing ratio	x	g/kg gr/lb	Ratio of water vapor mass per kilogram (or pound) of dry air.
Enthalpy	h	kJ/kg btu/lb	Sum of the internal energy of a thermodynamic system.

NOTE All of these parameters are visible and selectable using the service port (serial line and MI70 indicator use) even if your transmitter model does not have a humidity sensor. However, the transmitter will not show any measurement results for parameters that it cannot measure or calculate.

Transmitter parts

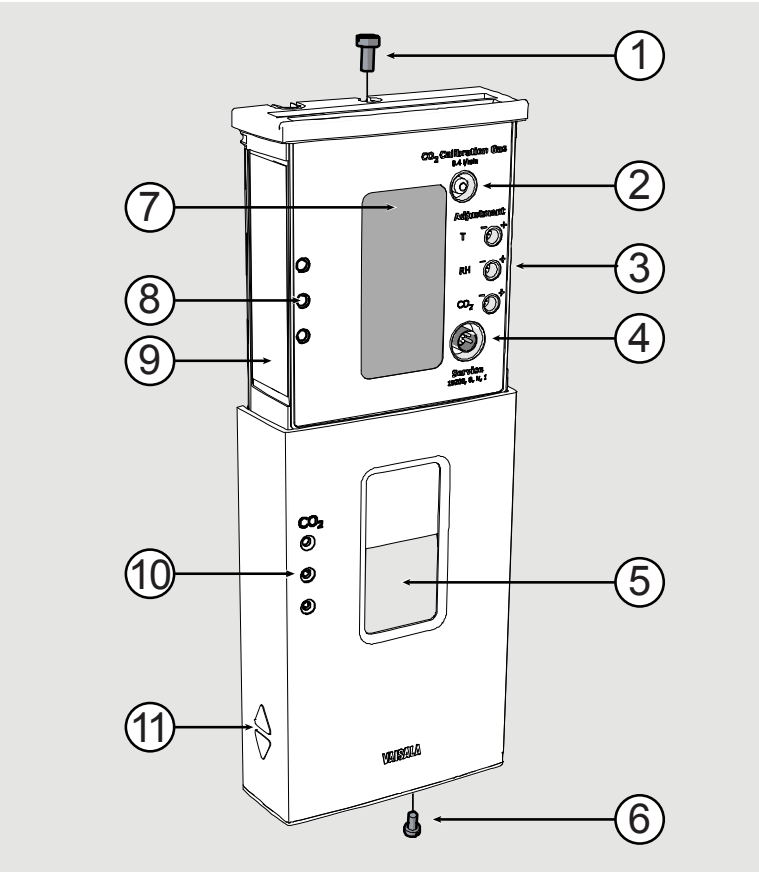


Figure 2 Transmitter Parts - Outside

1 = Locking screw for mounting base.
Not included, M3×6 recommended.
2 = Inlet for CO_2 calibration gas.
Use a 3 mm inner diameter silicone tube and 0.4 l/min flow.
3 = Adjustment trimmers.
4 = Service port.
5 = Window for display (only in models where the display is visible)
6 = Locking screw for slide. Not included, M3×6 recommended.
7 = Display.
8 = CO_2 level indicator LEDs. Enabled on models with LED option.
Default settings:

- Green LED (bottom): lit between 0 ... 800 ppm CO_2.
- Yellow LED (middle): lit between 800 ... 1200 ppm CO_2.
- Red LED (top): lit between 1200 ... 5000 ppm CO_2, blinking at > 5000 ppm CO_2.

9 = Type label.
10 = Holes for indicator LEDs (only in models with LED option).
11 = Grip for slide.

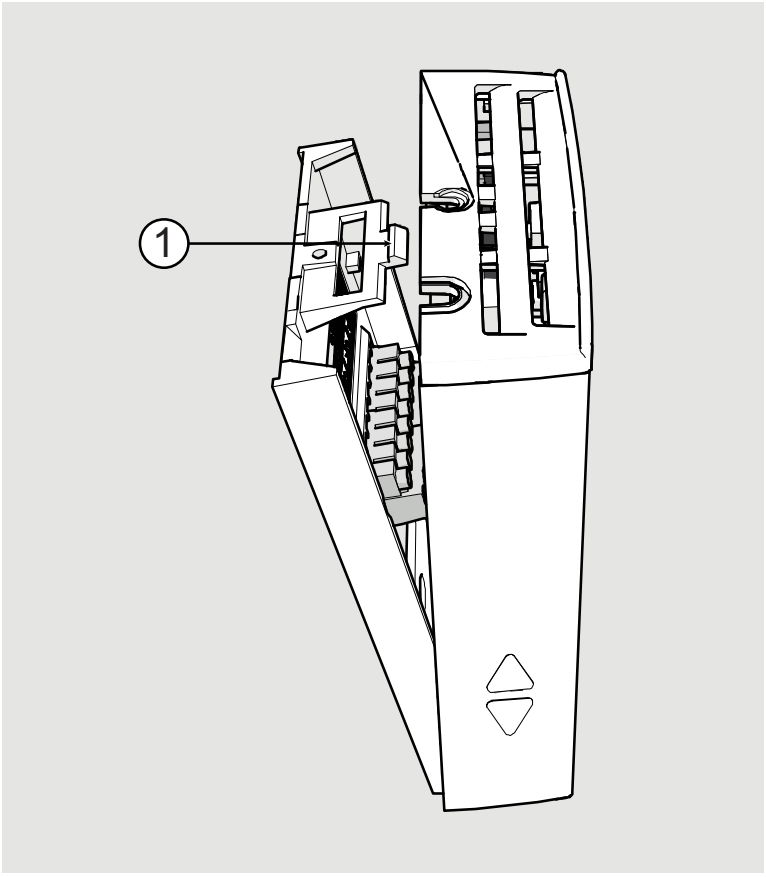


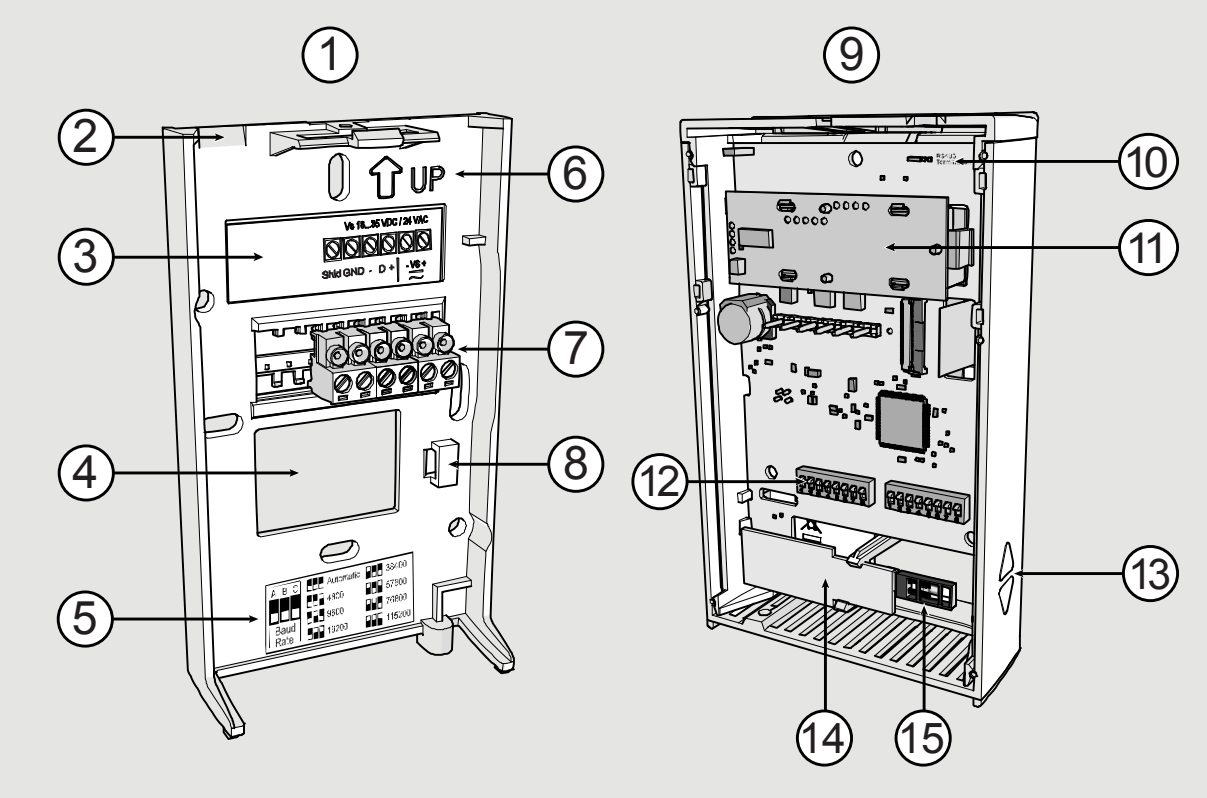
Figure 3 Opening the Transmitter

1 = Push tab down with a screwdriver to open the transmitter.

To open, use a screwdriver to push down the tab that holds the transmitter cover and mounting base together. Pull the mounting base away from the cover, starting from the top.

To close, connect the bottom of the transmitter first, and tilt the top forward to close the tab. Closing the transmitter starts it up if power is supplied to the screw terminals.

CAUTION	When opening or closing the transmitter, avoid damaging the transmitter electronics with the two plastic supports on the mounting base.



1310-039

Figure 4 Transmitter Parts – Inside

1 = Mounting base.
2 = Opening for cable (wiring from top).
3 = Terminal label.
4 = Opening for cable (wiring from behind, recommended).
5 = Label for RS-485 baud rate DIP switch settings.
6 = Orientation arrow – should point up after the mounting base has been installed.
7 = Screw terminals.
8 = Place for zip tie (for cable strain relief)
9 = Transmitter body.
10 = RS-485 termination jumper (connects a 120 Ω resistor).
11 = GM10 module (measures CO_2).
12 = DIP switches for common configuration options.
13 = Grip for slide.
14 = TM10 module (measures temperature only) or HTM10 module (measures humidity and temperature).
15 = HUMICAP® sensor (on models with humidity measurement).

Decorative Cover Option

The decorative cover is an installation accessory for HMW90 and GMW90 series transmitters that can be used to hide the transmitter from view. The cover material is transparent polycarbonate, but the idea is to customize it to match the wall the transmitter is on. There are two easy ways to change the cover's appearance:

- Paint the cover to the same color as the wall.
- Insert a piece of wallpaper under the lid.

You can also use the cover as a holder for printed material, for example an informational sign.

You must remove the sliding cover of the transmitter to install the decorative cover. Installation instructions are included with the cover.

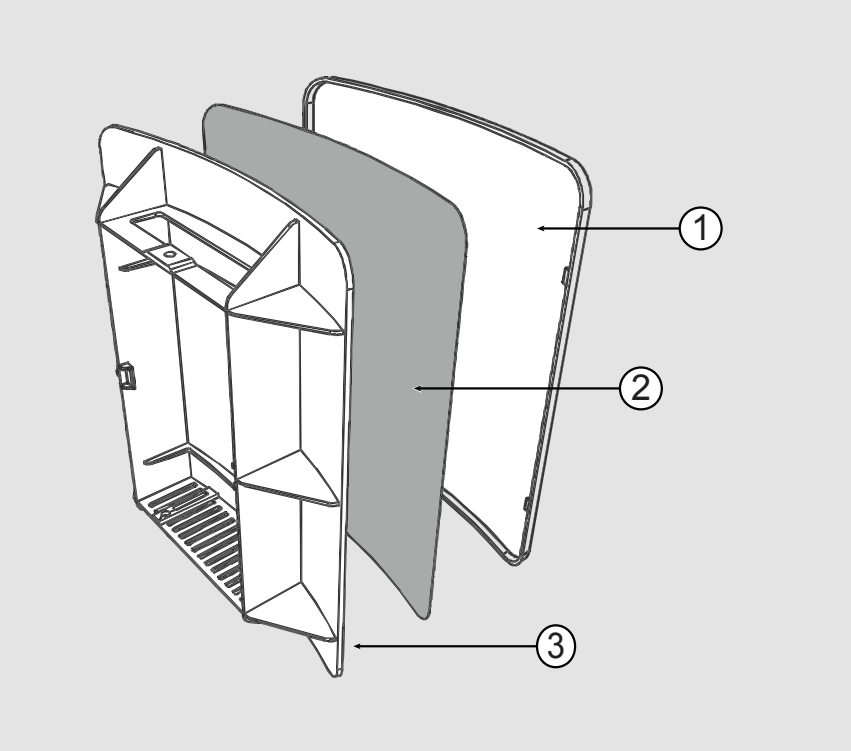


Figure 5 Decorative Cover

1 = Decorative cover lid. If you intend to paint the cover, paint the outer surface of this part, and leave the other part entirely unpainted.
2 = Space for wallpaper or printed insert. The decorative cover is delivered with a quick guide that can be used as a stencil for cutting the required shape.
3 = Decorative cover base part.

This page intentionally left blank.

CHAPTER 3

INSTALLATION

This chapter provides you with information that is intended to help you install the GMW90 series transmitters.

Configuration Before Installation

If you need to change the settings of the transmitter, it is best to do this before it has been installed.

Configuration of Digital Output Models

Digital output models of the GMW90 series have the following configuration interfaces:

- DIP switches on the component board control operating protocol, serial line settings, and transmitter MAC address. For instructions, see DIP Switches of Digital Output Models on page 22.
- You can set a jumper for RS-485 line termination on the component board (120 Ω resistor). For location of the jumper, see Figure 4 on page 18.
- Other settings are configured in software. You can change most configuration settings through the service port. For connection instructions and serial line commands, see Chapter 4, Operation, on page 29.
- Some configuration actions can be done using the BACnet and Modbus protocols. See the following appendices for protocol implementation details:
  - Appendix A, BACnet Reference, on page 75.
  - Appendix B, Modbus Reference, on page 89.

DIP Switches of Digital Output Models

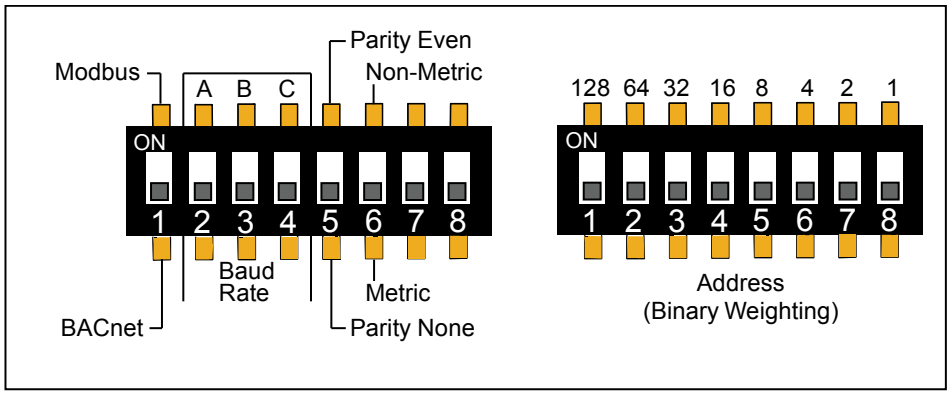


Figure 6 DIP Switch Settings of Digital Output Models

DIP	Position			Setting
1	Modbus			Modbus protocol in use.
	BACnet			BACnet protocol in use.
2 ... 4	A	B	C	Serial line baud rate.
	Off	Off	Off	Automatic (default).
	Off	Off	On	4800 (not available with BACnet protocol)
	Off	On	Off	9600
	Off	On	On	19200
	On	Off	Off	38400
	On	Off	On	57600
	On	On	Off	76800
	On	On	On	115200
5	Parity Even			Select 8E1 (parity even) for Modbus protocol.
	Parity None			Select 8N2 (parity none) for Modbus protocol.
6	Non-Metric			Use non-metric units on display and service port. No effect on Modbus and BACnet.
	Metric			Use metric units on display and service port. No effect on Modbus and BACnet.
7	Not used			
8	Not used			

NOTE If the serial line baud rate is set to **Automatic**, the transmitter attempts to determine the baud rate of the traffic in the RS-485 network. The transmitter cycles through all baud rate choices, listening for 10 seconds at each rate. When it detects valid RS-485 traffic, it remains at the detected baud rate until it is reset or power cycled.

Dip switches marked **Address (Binary Weighting)** set the MAC address of the GMW90 series digital transmitter. The address is encoded in eight bit binary form, with each numbered switch representing a single bit. For example:

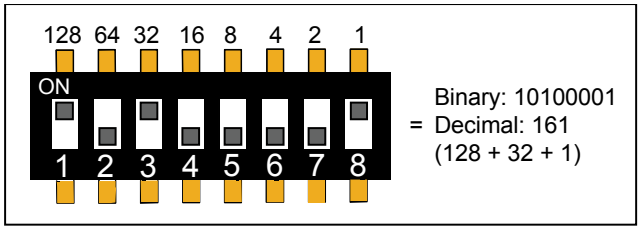


Figure 7 Example of Transmitter Addressing

Addressing with BACnet Protocol

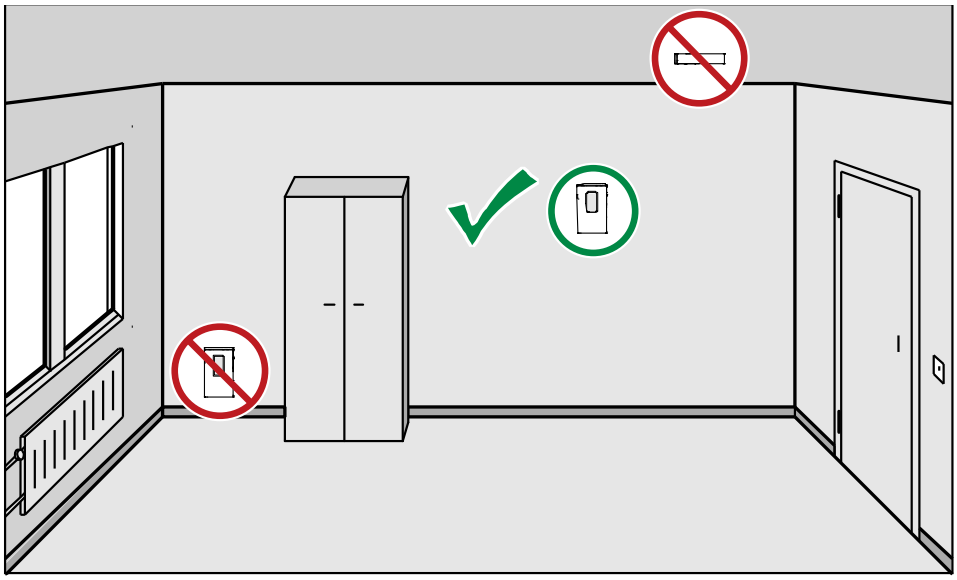
BACnet MS/TP MAC address range is 0 … 255. The transmitter is a BACnet MS/TP master if address is below 128. Otherwise the transmitter is a slave.

Addressing with Modbus Protocol

Transmitter is always a Modbus slave. MAC Address range for Modbus slaves is 1 … 247.

Selecting Location

The conditions at the location should represent well the area of interest. Do not install the transmitter on the ceiling. Avoid placing the transmitter near heat and moisture sources, close to the discharge of the supply air ducts, and in direct sunlight.



1111-070

Figure 8 Selecting Transmitter Location

Use the mounting holes to attach the mounting base securely. Use at least two screws (not included, max screw diameter 4 mm). Remember to leave sufficient clearance below the transmitter to operate the slide. For mounting dimensions, see section Dimensions in mm on page 74.

NOTE When bringing a cable through the wall, note that the hole may also supply air from outside the room into the transmitter. This may affect the measurement readings. For example, fresh concrete binds CO_2 and may cause low readings, especially in new buildings. Seal the cable opening if necessary.

Installing the Mounting Base

Use the mounting holes to attach the mounting base securely. Use at least two screws (not included). The arrow on the mounting base must point straight up after installation. **Proper orientation is important**: air must flow through the vents on the bottom and top.

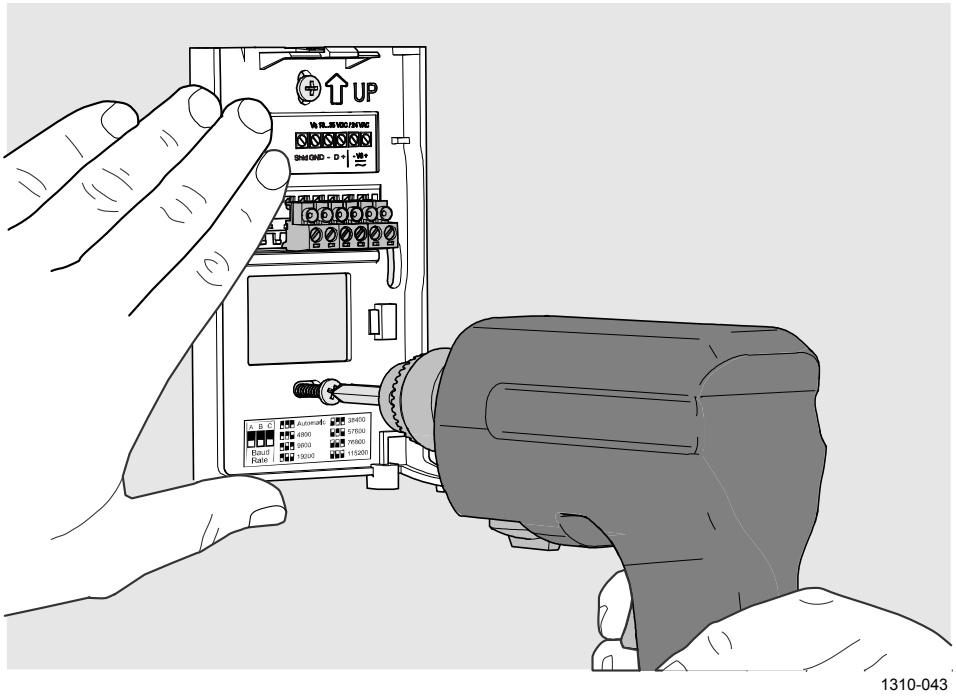


Figure 9 Installing the Mounting Base

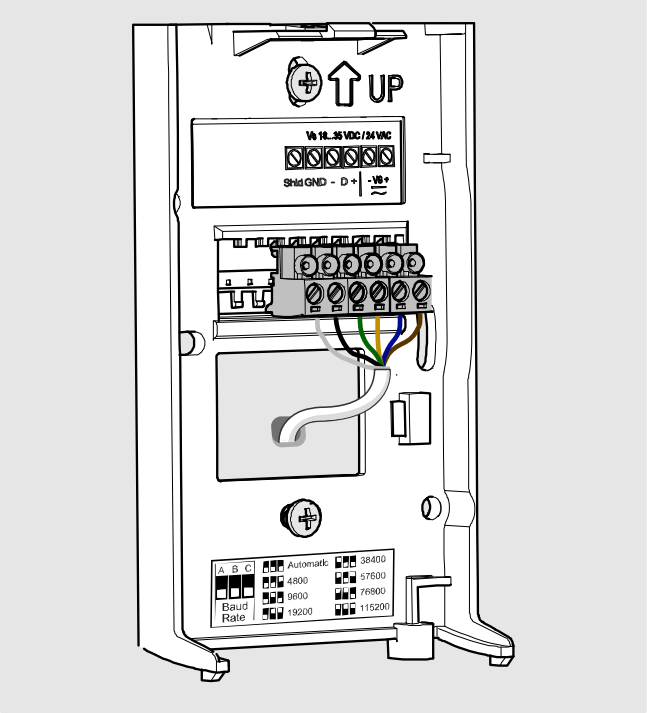
Wiring

Connect the wiring to the screw terminals on the mounting base. The supply voltage and terminal assignments are model-specific. Max wire size 2 mm^2 (AWG14).

You can bring the cable to the housing from above or from behind (recommended). If you are wiring a GMW90 series transmitter from above, note that the GM10 module takes up significant space inside the transmitter. To make sure there is enough space to close the transmitter, use a < Ø 5 mm cable, and route it from the left side of the mounting base. See Figure 11 on page 26.

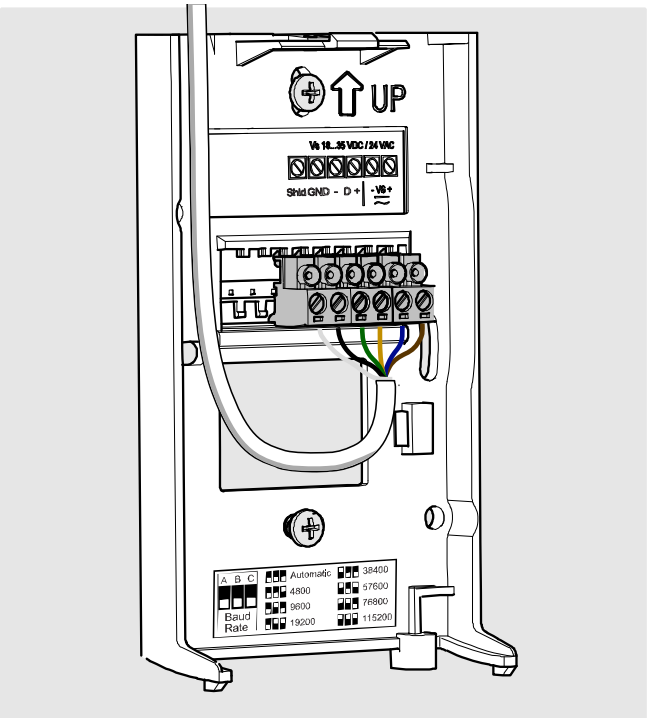
After completing the wiring, connect the transmitter body over the mounting base. Note that mounting bases are model-specific.

WARNING	Connect only de-energized wires.



1310-044

Figure 10 Wiring from Behind (Recommended)



1310-045

Figure 11 Wiring from Above

Wiring GMW95

The RS-485 line of the transmitter is isolated from the power supply. A separate ground reference terminal (**GND**) is provided for the RS-485 connection.

If you are using a shielded cable, you can use the **Shld** terminal to hold the exposed part of the shield. Note that the Shld terminal is floating (not electrically connected).

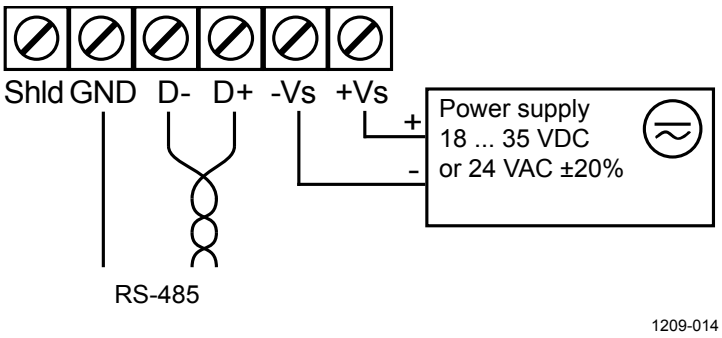


Figure 12 Wiring GMW95

Connecting Several Transmitters on Same RS-485 Line

Set the RS-485 termination jumper to "ON" on the transmitter that is at the end of the line. This terminates the line with a 120 Ω resistor. For location of the jumper, see section Transmitter Parts - Inside on page 6.

Connect the cable shield to ground on the building controller side.

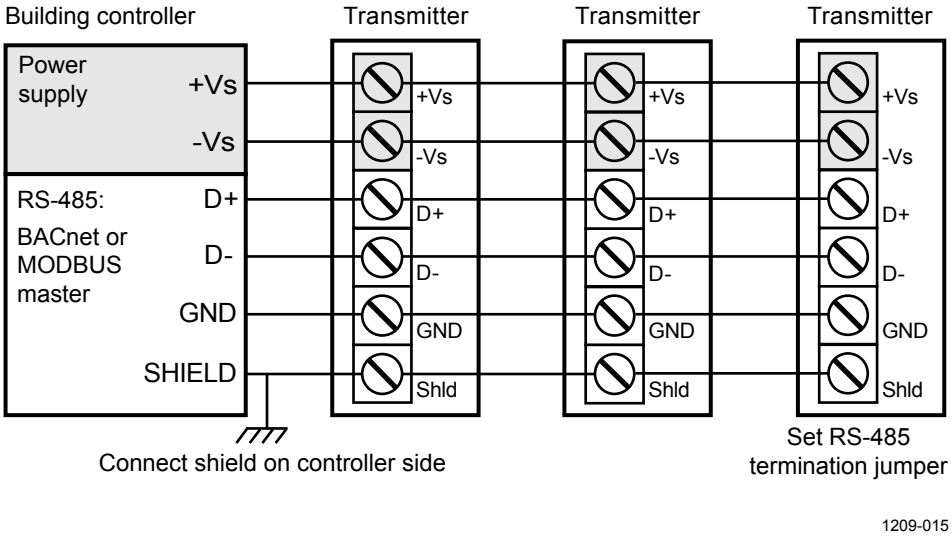


Figure 13 Several Transmitters on Same RS-485 Line

Connecting a Common AC Power Supply to Several Transmitters

If you are connecting a common 24 VAC power supply to several transmitters, make sure to connect the same terminal to +Vs and –Vs on all transmitters. This will avoid a short-circuit through the shared common line at the controller; see Figure 14 below.

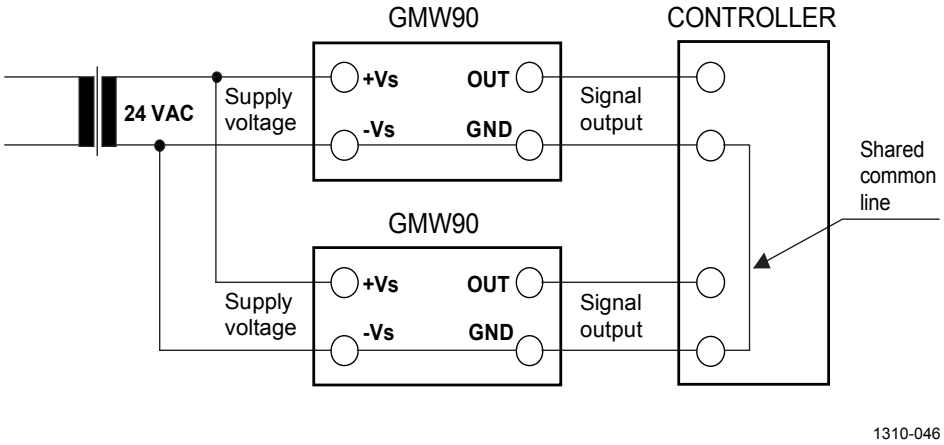


Figure 14 Connecting a Common AC Power Supply

CHAPTER 4

OPERATION

This chapter contains information that is needed to operate the GMW90 series transmitters.

Display

Startup Screens

When the transmitter is powered on, it displays a sequence of information screens. The screens are shown for a few seconds each.

The first screen identifies the transmitter and the connected measurement modules, and shows if the transmitter is operating normally (status OK) or if there is an error (status ERROR).

The second screen shows configuration information that is relevant to the selected communication protocol (BACnet or Modbus).

The third screen shows the currently configured pressure compensation setting.

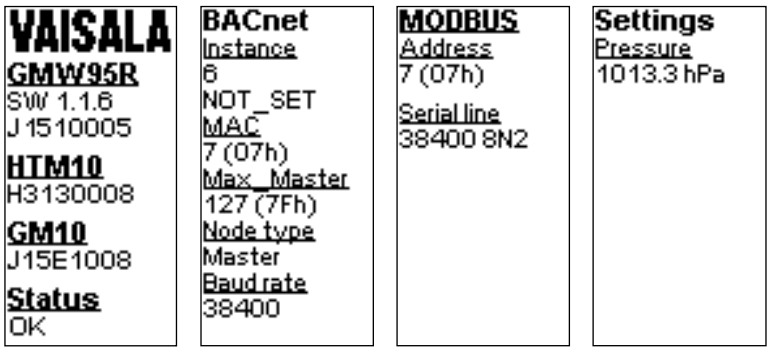


Figure 15 GMW95 Startup Screens

After the startup screens the transmitter shows the measurement screen. It shows the measured parameters and currently active indicators.

Measurement Screen

Measurement screen shows the measured parameters and currently active indicators.

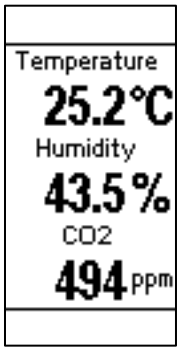


Figure 16 Measurement Screen – Normal Operation

If there is a problem with measurement, affected readings are replaced with stars. The alarm indicator and an error message will also appear on the screen.

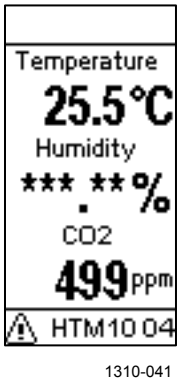


Figure 17 Measurement Screen – Problem With Humidity Measurement

Indicators on the Display

Indicator	Position on Screen	Meaning
	Top right	Communication arrows. Down arrow is shown when transmitter detects valid traffic on the RS-458 line. Up arrow is shown when transmitter is transmitting to the RS-485 line.
	Top left	MI70 connection indicator. Is shown when an MI70 Indicator is connected to the service port.
	Bottom left	Alert indicator and error text. Is shown if an error is active. The error message is written after the indicator. See section Error Messages on page 66.

Service Port

You can connect to the service port on the GMW90 series transmitters using a PC or an MI70 indicator. The MI70 indicator is the hand-held display device that is included with, for example, the Vaisala CARBOCAP® Hand-Held Carbon Dioxide Meter GM70.

CAUTION The service port is not galvanically isolated from the rest of the transmitter electronics. Connect only equipment with a floating power supply (not grounded) to the service port. If you connect a device that is grounded to a different potential than the transmitter's power supply, you will affect the accuracy of the transmitter's analog outputs. You may even affect the transmitter's functionality or cause damage to the transmitter.

Connecting With an MI70 Indicator

When connecting using an MI70 indicator, use the connection cable for GM70 hand-held meter (Vaisala order code 219980). The following functionality is available when using the MI70:

- Standard MI70 functions such as viewing, logging, and graphs of measurement results.
- Calibration and adjustment fuctions for the transmitter. For more information, see section Adjustment Using a on page 59.
- Setting of the pressure compensation value for carbon dioxide and humidity measurement (**Environment** menu in the MI70).

Connecting With a PC

Connecting with a PC allows you to configure and troubleshoot your transmitter using serial line commands. For a list of commands, see section List of Serial Commands on page 35.

When connecting using a PC, use the Vaisala USB cable (Vaisala order code 219690) and a suitable terminal application:

- If you have not used the Vaisala USB cable before, install the driver before attempting to use the cable. Refer to section Installing the Driver for the USB Service Cable on page 32 for detailed instructions.
- For more information on using a terminal application, see section Terminal Application Settings on page 33.

Installing the Driver for the USB Service Cable

Before taking the USB service cable into use, you must install the provided USB driver on your PC. When installing the driver, you must acknowledge any security prompts that may appear.

1. Check that the USB service cable is not connected. Disconnect the cable if you have already connected it.
2. Insert the media that came with the cable, or download the latest driver from www.vaisala.com.
3. Execute the USB driver installation program (setup.exe), and accept the installation defaults. The installation of the driver may take several minutes.
4. After the driver has been installed, connect the USB service cable to a USB port on your PC. Windows will detect the new device, and use the driver automatically.
5. The installation has reserved a COM port for the cable. Verify the port number, and the status of the cable, using the **Vaisala USB Instrument Finder** program that has been installed in the Windows Start menu.

Windows will recognize each individual cable as a different device, and reserve a new COM port. Remember to use the correct port in the settings of your terminal program.

There is no reason to uninstall the driver for normal use. However, if you wish to remove the driver files and all Vaisala USB cable devices, you can do so by uninstalling the entry for **Vaisala USB Instrument Driver** from the **Programs and Features** menu in the Windows Control Panel. In Windows XP and earlier Windows versions the menu is called **Add or Remove Programs.**

Terminal Application Settings

The serial interface settings of the service port are presented in Table 6 below. The settings are fixed, and cannot be changed by the user.

Table 6 Serial Interface Settings

Property	Description / Value
Baud rate	19200
Parity	None
Data bits	8
Stop bits	1
Flow control	None

The steps below describe how to connect to the transmitter using the PuTTY terminal application for Windows (available for download at www.vaisala.com) and a USB serial interface cable:

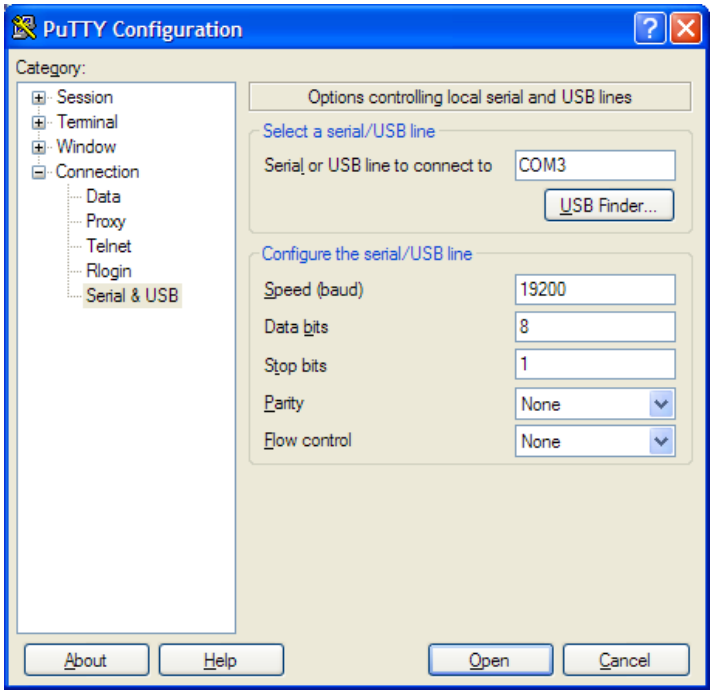
1. Connect the USB serial interface cable between your PC and the service port of the transmitter.
2. Start the PuTTY application.
3. Select the **Serial** settings category, and check that the correct COM port is selected in the **Serial line to connect to** field.

   Note: You can check which port the USB cable is using with the **Vaisala USB Instrument Finder** program that has been installed in the Windows Start menu.
4. Check that the other serial settings are correct for your connection, and change if necessary. **Flow control** should be set to **None** unless you have a reason to change it.
5. Click the **Open** button to open the connection window and start using the serial line.

NOTE If PuTTY is unable to open the serial port you selected, it will show you an error message instead. If this happens, restart PuTTY and check the settings.

6. You may need to adjust the **Local echo** setting in the **Terminal** category to see what you are typing on the serial line. You must enable either local echo (on the terminal side) or remote echo (on the transmitter side, adjustable using the **ECHO** command).

   To access the configuration screen while a session is running, click the right mouse button over the session window, and select **Change Settings...** from the pop-up menu.



0807-004

Figure 18 PuTTY Terminal Application

List of Serial Commands

All commands can be issued either in uppercase or lowercase. In the command examples, the keyboard input by the user is in **bold** type.

The notation <cr> refers to pressing the carriage return (**Enter**) key on your computer keyboard. Enter a <cr> to clear the command buffer before starting to enter commands.

Some commands, such as **CRH**, are not available if the required feature is not present on the transmitter, or the command is not relevant.

Table 7 Basic Serial Commands

Command	Description
?	Show transmitter information.
CALCS	Show all measured and calculated parameters.
ECHO	Show or set remote echo mode.
ENV	Show or set environmental parameters.
ERRT	Show error table.
ERRS	Show currently active errors.
FORM [modifier string]	Show or set output format.
HELP	Show list of currently available serial commands.
INTV [0 ... 9999 s/min/h]	Set continuous output interval for R command.
PASS [9000]	Access advanced serial commands.
R	Start the continuous outputting.
RESET	Reset the transmitter.
S	Stop the continuous outputting.
SDELAY [0 ... 255]	Show or set serial line turnaround delay in milliseconds.
SEND	Output measurement message once.
SNUM	Show transmitter serial number.
STATUS	Show transmitter status.
VERS	Show transmitter firmware version.

Table 8 Advanced Serial Commands

Command	Description
BACNET	Show or set BACnet parameters.
CCO2	Calibrate and adjust CO_2 measurement.
CDATE	Show or set calibration date.
CRH	Calibrate and adjust RH measurement.
CT	Calibrate and adjust T measurement.
CTEXT	Show or set calibration information.
DSEL	Select parameters to display on screen.
FRESTORE	Restore transmitter to factory settings.

Transmitter Information

Show Transmitter Information

The **?** command outputs a listing of device information.

?<cr>

Example:

```
>?
Device              : GMW95R
SW version          : 1.1.28.5849
SNUM                : H2930002

HTM10 module information
Software version    : 0.11.1
SNUM                : H2950107

GM10 module information
Software version    : 1.1.0
SNUM                : J04C030105
```

Show Transmitter Firmware Version

Use the **VERS** command to show the transmitter model and firmware version.

VERS<cr>

Example:

```
>vers
GMW95R / 1.1.28
```

Show Transmitter Serial Number

Use the **SNUM** command to show the transmitter serial number.

SNUM<cr>

Example:

```
>snum
Serial number       : H2930002
```

Show Transmitter Status

Use the **STATUS** command to view detailed information on transmitter model and configuration.

STATUS [*function*]<cr>

where

Function = Optional switch to display a more detailed status for BACnet or Modbus protocol (available on transmitter models with digital output). Available switches are `-bacnet` and `-modbus`.

Example (display detailed BACnet status):

```
>status -bacnet
* BACnet module (BACNET) *
BACnet protocol     : active
MAC                 : 0 (00h)
Device Instance     : 6 (00000006h)
Name                : GMW95R_ H2930002
Location            : Location
Description         : Description
MAX_MASTER          : 127 (7Fh)
Node type           : Master
Baud setting        : Auto
Current baudrate    : 19200 8N1
Baudrate locked     : No
Baud detection interval: 10 s
DCC                 : Communication enabled
Valid frames        : 0
Invalid frames      : 0
Unwanted frames     : 0
Lost tokens         : 0
Failed TX           : 0
```

Example (display full status):

```
>status
Device Name          : GMW95R
Copyright            : Copyright Vaisala Oyj 2013
SW Name              : XM90
SW Model             : XM9x
SW version           : 1.1.28.5849
Serial number        : H2930002
Address              : 0

SUB FUNCTIONS

* Serial Port (COM1) *
Mode                 : STOP

* Error Manager (ERR) *
Status               : NORMAL
Active errors        : 0

* MCI communication (MCI) *
Status               : NORMAL

* Measurement module (HTM10) *
Status               : NORMAL
Factory date         : 20130720

* Measurement module (GM10) *
Status               : NORMAL
Calibration          : 20130819

* BACnet module (BACNET) *
BACnet protocol      : active
MAC                  : 0 (00h)
Device Instance      : 6 (00000006h)
Name                 : GMW95R_ H2930002
Location             : Location
Description          : Description
MAX_MASTER           : 127 (7Fh)
Node type            : Master
Baud setting         : Auto

* MODBUS module (MODBUS) *
MODBUS protocol      : inactive
```

Show Measured Parameters

Use the **CALCS** command to list the measurement parameters that are supported by the GMW90 series transmitters. CO_2, RH and T are measured directly by the transmitter, the rest are calculated based on the measured values.

CALCS<cr>

Example:

```
>calcs
RH        - Relative Humidity
T         - Temperature
Tdf       - Dew/Frost point temperature
Td        - Dew point temperature
Tw        - Wetbulb temperature
h         - Enthalpy
x         - Mixing ratio
a         - Absolute humidity
dTd       - Dew/frostpoint depression
CO2       - Filtered CO2
```

NOTE	CALCS command also lists all humidity parameters, even if your transmitter model does not measure humidity.

Show Command Help

To see a short description of an individual command, issue the command with a question mark as a parameter.

Example:

```
>calcs ?
Display measured quantities
```

Show Command List

Use the **HELP** command to list the currently available serial commands. If the **PASS** command has not been used, only the basic serial commands are available.

HELP<cr>

Example (shows basic serial commands, advanced commands are not enabled here):

```
>help
?
CALCS
ECHO
ENV
ERRT
ERRS
FORM
HELP
INTV
PASS
R
RESET
SDELAY
SEND
SNUM
STATUS
VERS
```

Measurement Settings

Set Environmental Parameters

Use the **ENV** command to set environmental parameters that affect the measurement. For GMW90 series transmitters you can set the ambient pressure value that is used for pressure compensation of CO_2 measurement and calculated humidity parameters.

ENV [*pressure*]<cr>

where

pressure = Ambient pressure in hPa.

Example:

```
>env 1013.3
Pressure (hPa)      : 1013.3
```

Display Settings

Select Parameters to Display

Use the **DSEL** command to select the parameters that are displayed on the transmitter screen. You can select parameters by abbreviation. If only one parameter is selected, it is shown vertically centered on the transmitter screen.

DSEL [*Q1 Q2 Q3*]<cr>

where

Q1 = First parameter to show on the screen. Available parameters are:

CO2	carbon dioxide level
CO2_10	carbon dioxide level in 10 ppm steps
RH	relative humidity
T	temperature
Tdf	dew/frost point temperature
Td	dew point temperature
Tw	wetbulb temperature
h	enthalpy
x	mixing ratio
a	absolute humidity
dTd	dew/frost point depression

Q2 = Second parameter to show on the screen. Available parameters are the same as for Q1.

Q3 = Third parameter to show on the screen. Available parameters are the same as for Q1.

Example (show currently displayed parameters):

```
>pass 9000
>dsel
Quant 1             : RH
Quant 2             : T
Quant 3             : CO2
```

Example (change display to only show CO2):

```
>dsel CO2
OK
```

Serial Line Output Commands

Start Measurement Output

Use the **R** command to start the continuous outputting of measurement values as an ASCII text string to the serial line. The format of the measurement message is set with the **FORM** command.

R<cr>

Example (measurement message in default format):

```
>r
RH = 26.44 %RH T = 24.27 'C CO2 = 449 ppm
RH = 26.45 %RH T = 24.27 'C CO2 = 449 ppm
RH = 26.43 %RH T = 24.27 'C CO2 = 449 ppm
RH = 26.43 %RH T = 24.27 'C CO2 = 449 ppm
...
```

Outputting the results continues in intervals issued with the command **INTV**. You can stop the output with the **S** command. Since the interface is half-duplex, you must enter the commands when the transmitter is not outputting.

Stop Measurement Output

You can stop the measurement output with the **S** command:

S<cr>

Output a Reading Once

Use the **SEND** command to output a single measurement message.

SEND<cr>

Example:

```
>send
RH = 26.44 %RH T = 24.27 'C CO2 = 449 ppm
```

Set Output Interval

Use the **INTV** command to change the output interval of the automatically repeating measurement messages. The measurement messages are repeated in the RUN mode, or after the **R** command has been given.

INTV [*n xxx*]<cr>

where

n = time interval, range 0 ... 9999.
xxx = time unit = "S", "MIN", or "H"

The shortest output interval (with n = 0) outputs the measurement messages as quickly as the transmitter produces them, without additional delay.

Example:

```
>intv 1 min
Output interval     : 1 min
```

Set Output Format

Use the serial line command **FORM** to change the measurement message sent by the transmitter on the service port. You can freely define the output message to include the desired parameters, formatting options, text strings, and additional fields.

FORM [*modifier string*]<cr>

where

modifier string = String of parameters and modifiers that defines the output format, length 1 ... 150 characters. Maximum length may be shorter when text strings are used. See Table 9 and Table 10 on page 45, and examples below.

Command to set default format:

>**form /**

Example of default output (default depends on transmitter model):

```
RH = 26.44 %RH T = 24.27 'C CO2 = 449 ppm
RH = 26.45 %RH T = 24.27 'C CO2 = 449 ppm
RH = 26.43 %RH T = 24.27 'C CO2 = 449 ppm
RH = 26.43 %RH T = 24.27 'C CO2 = 449 ppm
...
```

Command to set output format as CO_2 and T with Modulus-256 checksum:

>**form "CO2 =" U4 4.0 CO2 " T =" U3 3.2 t CS2 \r \n**

Output example:

```
CO2 = 479 ppm  T = 24.26 'C E9
CO2 = 477 ppm  T = 24.27 'C E8
CO2 = 475 ppm  T = 24.27 'C E6
CO2 = 475 ppm  T = 24.27 'C E6
...
```

Command to set output format as CO_2 and T, with **start of text** (ASCII character 002) and **end of text** (003) ASCII codes, and without line feed and carriage return at the end:

>**form #002 "CO2 =" U4 4.0 CO2 " T =" U3 3.2 t #003**

Output example (ASCII codes not visible here):

```
CO2 = 817 ppm  T = 24.26 'CCO2 = 806 ppm  T = 24.27 'CCO2 =
800 ppm  T = 24.27 'CCO2 = 788 ppm  T = 24.27 'CO2 = 781
ppm  T = 24.27 'CCO2 = 768 ppm  T = 24.27 'C...
```

Table 9 FORM Command Parameters

Measured Parameter	Abbreviation in FORM Command
Carbon dioxide	CO2
Relative humidity	RH
Temperature	T
Dew/frost point temperature	Tdf
Dewpoint temperature	Td
Wetbulb temperature	Tw
Enthalpy	h
Mixing ratio	x
Absolute humidity	a
Dew/frost point depression	dTd

Table 10 FORM Command Modifiers

Modifier	Description
x.y	Length modifier (number of digits and decimal places)
#t	Tabulator
#r	Carriage-return
#n	Line feed
""	String constant, length 1 ... 15 characters
#xxx	ASCII code value (decimal) of a special character; for example, **#027** for ESC
Ux	Shows the name of the measurement unit using "x" number of characters. For example, **U3** shows the name of the measurement unit with three characters
CS2	Modulus-256 checksum of message sent so far, ASCII encoded hexadecimal notation
CS4	Modulus-65536 checksum of message sent so far, ASCII encoded hexadecimal notation
CSX	NMEA xor-checksum of message sent so far, ASCII encoded hexadecimal notation

NOTE When entering modifiers, you can also use the backslash character "\" instead of the hash "#".

Serial Line Settings

Set Remote Echo

Use the **ECHO** command to enable or disable remote echo by the transmitter.

ECHO [*on/off*]<cr>

Example:

```
>echo on
Echo                : ON
```

Set Serial Line Turnaround Delay

With the **SDELAY** command you can set the turnaround delay of the transmitter (time waited before replying to an incoming message) or view the currently set delay value.

SDELAY [*delay*]<cr>

where

delay = Turnaround delay in milliseconds, range 1 … 1000.

Example:

```
>sdelay 5
COM1 transmit delay : 5
```

Calibration and Adjustment Commands

The following sections describe the calibration and adjustment commands of the GMW90 series. For general information on performing calibration and adjustment on the serial line, see section Adjustment Using a PC on page 60.

NOTE	You must enable advanced serial commands using the **PASS 9000** command before using the calibration and adjustment commands.

Adjust CO_2 Measurement

Use the **CCO2** command to adjust the carbon dioxide (CO_2) measurement. You can do a 1-point or a 2-point adjustment, or clear the adjustment information from the GM10 module. Note that the factory adjustment will remain intact when user adjustment is cleared.

Remember to let the transmitter stabilize in the reference concentration before entering the adjustment command. Three minutes is typically enough.

NOTE	Before using the **CCO2** command, read section Notes for CO2 Adjustment on page 56.

Show Current CO_2 Adjustment

In addition to the user-adjustable offset and gain values, the **CCO2** command displays diagnostic information that may be useful to Vaisala Helpdesk if there is a problem with the adjustment.

CCO2<cr>

Example:

```
>pass 9000
>cco2
User gain           : 1.000
User offset         : -8.365
CO2 (pre-adjust)    : 464.625
30s delta           : 13.904
30s stddev          : 4.429
Adjustability       : CAN_ADJUST
```

1-point Adjustment of CO_2 Measurement

The 1-point adjustment adjusts either offset or gain, depending on the CO_2 concentration.

CCO2 [*ONE*] [*x*]<cr>

where

x = The reference CO_2 concentration (ppm) that the transmitter should be showing.

Example:

```
>pass 9000
>cco2 one 440
OK
```

2-point Adjustment of CO_2 Measurement

The 2-point adjustment adjusts both offset and gain.

CCO2 [*LO* | *HI*] [*x*]<cr>

where

LO = Adjustment point at low concentration (< 700 ppm).
HI = Adjustment point at high concentration (> 700 ppm).
x = The reference CO_2 concentration (ppm) that the transmitter should be showing.

The 2-point correction is not applied immediately – you must use the **CCO2 SAVE** command to store your adjustment to the GM10 module. If you have entered user adjustments using the **CCO2** command but do not wish to commit them, use the **CCO2 CANCEL** command.

CCO2 [*SAVE* | *CANCEL*]<cr>

Example (two point adjustment, low concentration 0 ppm and high concentration 1000 ppm):

```
>pass 9000
>cco2 lo 0
OK
>cco2 hi 1000
OK
>cco2 save
OK
```

Clear User Adjustment of CO_2 Measurement

CCO2 [*RESET*]<cr>

Example:

```
>pass 9000
>cco2 reset
OK
```

Adjust Humidity Measurement

Use the **CRH** command to perform a humidity adjustment of the relative humidity (RH) measurement. You can do a 1-point or a 2-point adjustment, or clear the adjustment information from the HTM10 module. Note that the factory adjustment will remain intact when user adjustment is cleared.

NOTE	Before using the **CRH** command, read section Notes for RH Adjustment on page 57.

Show Current RH Adjustment

CRH<cr>

Example (showing default offset and gain):

```
>pass 9000
>crh
RH Gain             : 1.000
RH Offset           : 0.000
```

1-point Adjustment of RH Measurement

The 1-point adjustment adjusts both offset and gain depending on the adjustment condition. The same type of adjustment is done when turning the RH trimmer.

Place the transmitter in the reference condition and allow it to stabilize before entering the adjustment.

CRH [*ONE*] [*x*]<cr>

where

x = The reference humidity condition (%RH) that the transmitter should be showing.

Example:

```
>pass 9000
>crh one 11
OK
```

2-point Adjustment of RH Measurement

CRH [*LO* | *HI*] [*x*]<cr>

where

LO = Adjustment point at the dry end (low RH).
HI = Adjustment point at the wet end (high RH). The difference between the two points should be at least 30 %RH.
x = The reference humidity condition (%RH) that the transmitter should be showing.

The 2-point correction is not applied immediately – you must use the **CRH SAVE** command to store your adjustment to the HTM10 module. If you have entered user adjustments using the CRH command but do not wish to commit them, use the **CRH CANCEL** command.

CRH [*SAVE* | *CANCEL*]<cr>

Example (two point adjustment, low point 11 %RH and high point 75 %RH):

```
>pass 9000
>crh lo 11
OK
>crh hi 75
OK
>crh save
OK
```

Clear User Adjustment of RH Measurement

CRH [*RESET*]<cr>

Example:

```
>pass 9000
>crh reset
OK
```

Adjust Temperature Measurement

Use the **CT** command to perform an adjustment of the temperature measurement. You can do a 1-point adjustment or clear the adjustment information from the HTM10 module. Note that the factory adjustment will remain intact when user adjustment is cleared.

Show Current T Adjustment

CT<cr>

Example (showing default temperature offset):

```
>pass 9000
>ct
Temperature offset  : 0.000
```

1-point Adjustment of T Measurement

Place the transmitter in the reference condition and allow it to stabilize before entering the adjustment.

CT [*x*]<cr>

where

x = The reference temperature (in degrees Celsius) that the transmitter should be showing.

Example:

```
>pass 9000
>ct 23
OK
```

Clear User Adjustment of T Measurement

CT [*RESET*]<cr>

Example:

```
>pass 9000
>ct reset
OK
```

Enter Calibration and Adjustment Information

Use the **CTEXT** command to store a text string that describes the calibration and/or adjustment. To enter a text string with spaces, enclose the string in quotation marks. Use the **CDATE** to store the date.

CTEXT [*text*]<cr>

CDATE [*YYYY-MM-DD*]<cr>

Examples:

```
>pass 9000
>ctext "adjusted rhlab/Tech021"
"adjusted rhlab/Tech021"

>cdate 2011-12-08
Calibration date    : 2011-12-08
```

Other Commands

Enable Advanced Serial Commands

Use the **PASS** command to enable the advanced serial commands.

PASS [*passcode*]<cr>

where

passcode = Passcode to enable advanced commands is **9000**.

Example:

```
>pass 9000
```

Reset Transmitter

Use the **RESET** command to reset the transmitter.

RESET<cr>

Example:

```
>reset
Resetting
GMW95R / 1.1.28.5849 / XM90
>
```

Set BACnet Parameters

Use the **BACNET** command to show or set some of the transmitter's BACnet parameters. You can also use the **BACNET** command to reinitialize the BACnet stack of the transmitter without having to reset or power cycle the transmitter.

BACNET [*parameter_name* [*parameter_value*]] [*reinit*]<cr>

where

parameter_name = Name of the BACnet parameter to change. Available parameters are:

Instance: BACnet instance number. Unsigned value in range 0 ... 4194302.

Name: BACnet Object_Name shown in the Device object. String value, no spaces.

Description: BACnet Description shown in the Device object. String value, no spaces.

Location: BACnet Location shown in the Device object. String value, no spaces.

Password: Password used in ReinitializeDevice service. String value, no spaces.

MAX_MASTER: Max_Master parameter in Device object. Unsigned value, range 1 ... 127.

parameter_value = New value of the parameter. See descriptions above for allowed values.

reinit = Reinitializes the BACnet stack. Must be given as the only argument for the **BACNET** command.

Example (show BACnet parameters):

```
>pass 9000
>bacnet
Instance            : 6 (00000006h)
Name                : GMW95R_ H2930002
Location            : Location
Description         : Description
Password            : 1234
MAX_MASTER          : 127 (007Fh)
COV_Interval        : 0
Autobaud_Interval   : 10
```

Example (change Description to **main_hall**, and reinitialize the BACnet stack):

```
>pass 9000
>bacnet description main_hall
Description         : main_hall
>bacnet reinit
Reinitialize signaled to BACnet stack.
```

CHAPTER 5

MAINTENANCE

This chapter provides information that is needed in basic maintenance of the GMW90 series.

Cleaning

The body of the transmitter can be cleaned by wiping with a moistened lint-free cloth. Do not use cleaning agents or solvents, or blow pressurized air into the transmitter housing.

Do not attempt to clean contaminated measurement modules. Dirty modules should always be replaced with new calibrated modules.

Calibration and Adjustment

GMW90 series transmitters are fully calibrated as shipped from factory. GMW90 series transmitters have a display that makes it easy to compare the measured readings against any portable calibration reference. Note that depending on the ordered configuration, the display may be hidden under the sliding cover.

Adjustment Methods

You can adjust the measurements in the following ways:

- 1-point adjustment using the trimmers under the sliding cover. See section Adjustment Using Display and Trimmers on page 58.
- 1-point or 2-point adjustment using the service port. See the following sections:
  - Adjustment Using a Hand-Held Meter on page 59.
  - Adjustment Using a PC on page 60.

If adjustment is not enough to restore the measurement accuracy of the transmitter, you can also replace the measurement modules. See section Repair Maintenance on page 61.

Notes for CO_2 Adjustment

1-point CO_2 adjustment affects either offset or gain, depending on the gas concentration. 1-point adjustment below 700 ppm affects the measurement offset, above 700 ppm it affects the gain.

2-point adjustment will adjust both offset and gain. Choose the adjustment points as follows:

- For first point, use as low concentration as possible. Preferably 0 ppm, must be below 700 ppm.
- For second point, use as high concentration as is relevant for your application. Must be within 700 ... 5000 ppm.

Using Calibration Gas vs. Ambient Gas

You can adjust using a calibration gas with a known concentration (recommended), or adjust using the ambient gas:

- When using a calibration gas, feed the gas to the adjustment inlet at a flow rate of 0.3 ... 0.7 L/min. For location of the inlet, see Figure 2 on page 16. After connecting the gas supply to the field adjustment inlet, wait for at least three minutes for the reading to stabilize.
- When using ambient gas for adjustment, avoid breathing near the transmitter during the adjustment.

Regardless of the CO_2 reference used, it is important to let the CO_2 measurement stabilize before performing the adjustment. Three minutes is typically enough. Also allow for the stabilization period after adjustment, before verifying the result.

Effect of Temperature on CO_2 Measurement

The device is fully temperature compensated using internal temperature measurement.

Effect of Pressure on CO_2 Measurement

Ambient pressure affects the CO_2 reading of GMW90. If the ambient pressure differs from the normal pressure 1013 hPa, the transmitter can correct the reading if you enter the correct pressure value to the transmitter using an MI70 indicator or a PC (**ENV** command).

When adjusting the transmitter, you can also correct your reference concentration (for example, the value on the gas cylinder label) according to the graph below.

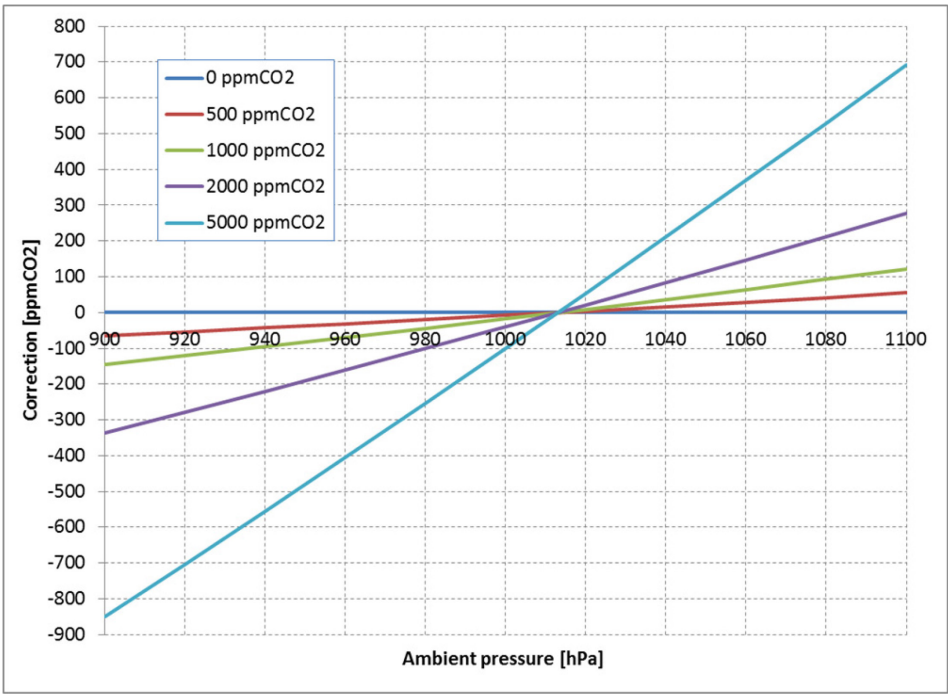


Figure 19 Effect of Pressure on CO2 Reading

Notes for T Adjustment

Temperature adjustment is always a simple 1-point offset correction.

Notes for RH Adjustment

1-point humidity adjustment affects both offset and gain, depending on the adjustment condition. In a dry condition (for example, 11 %RH), offset is adjusted more than gain.

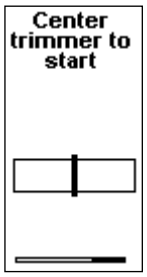
The 1-point humidity adjustment requires that the target condition is at least 50% of the currently measured value. This prevents the user from making excessive corrections that are very unlikely to be needed.

Adjustment Using Display and Trimmers

CAUTION	The trimmers only turn 135 degrees each way, less than half a rotation. Do not force the trimmer past the stopping point. If you wish to apply a greater correction than allowed by the trimmer in a single adjustment, simply adjust the transmitter again. Corrections applied using the trimmers are cumulative.

NOTE	User calibration settings (adjustment by trimmers or service port) are stored in the measurement modules. If you replace a module, there is no need to undo previous adjustments.

1. To enter the adjustment screen, open the slide and rotate the CO_2, T, or RH trimmer slightly during normal measurement. If the trimmer is not centered, you see the trimmer centering screen first. Simply turn the trimmer to the center and wait for the progress bar to complete.



1111-075

Figure 20 Trimmer Centering Screen

2. In the adjustment screen, turn the trimmer to set the desired correction. To commit the change, stop turning the trimmer and wait.

1310-092

Figure 21 Adjustment Screen

3. If you have adjusted the CO_2 measurement, wait for three minutes for the reading to stabilize.
4. Verify the adjusted measurement from measurement screen.

Adjustment Using a Hand-Held Meter

GMW90 transmitters can be adjusted using Vaisala hand-held meters HM70 (for humidity and temperature) and GM70 (for carbon dioxide and temperature).

1. Connect the GMW90 series transmitter to the MI70 indicator using the connection cable (Vaisala order code 219980). MI70 indicator is the hand-held display device that is included with HM70 and GM70.
2. Depending on the connected devices, you may be prompted by the to check the currently applied environment settings. Check the settings when prompted.
3. In the **Functions** menu of the MI70 indicator, select **Calibrate XMW9x** and press **Start**.
4. Confirm **Yes**. Confirm the automatic power off notification with **Ok**.
5. Select parameter for adjustment: CO_2, RH, or T.
6. Screen shows the measured values and their difference. Press **Adjust** to select the Adjustment mode.
7. Select the desired adjustment type using arrow buttons and press **Select**:
   - **To same as reference**: Adjusts the measurement of the GMW90 transmitter to the same reading as the reference that is connected to the other port. This option is not available if no reference for the selected parameter is connected to the MI70 indicator.
   - **1-point adjustment**: Adjusts the measurement of the GMW90 to a reference value that you specify. Follow the instructions from the HM70 when using this option.
   - **2-point adjustment**: Adjusts the measurement of the GMW90 at two points to reference values that you specify. This option is not available when adjusting temperature (T).
   - **Revert factory calib.**: This option removes the currently applied user adjustment from the measurement module (GM10 module for CO2, HTM10 module for RH or T). Only the adjustment for the selected parameter is removed.
8. Complete the selected adjustment by following the instructions from the MI70 indicator.

Adjustment Using a PC

For more detailed instructions on using the Vaisala USB cable and a terminal application, see section Connecting With a PC on page 32.

For a description of the serial commands, see section Calibration and Adjustment Commands on page 47.

1. Connect the GMW90 series transmitter to your PC using the Vaisala USB cable (order code 219690).
2. Start a terminal application and open a new session to the service port of the transmitter. The serial line settings are 19200, N, 8, 1.
3. Before changing the adjustment, issue the following commands to see the transmitter's current adjustment information:

   ```
   pass 9000
   cco2
   ct
   crh
   ctext
   cdate
   ```

   Note that the **CRH** command is not available if your transmitter does not support humidity measurement.

4. Place the entire transmitter in the desired reference condition and allow the measurement to stabilize. Follow the stabilization from the serial line (output from the **R** command) or the display.
5. You can now use the **CCO2**, **CT**, and **CRH** commands to adjust the transmitter's measurement. Refer to the command descriptions for the available options.
6. After performing the adjustment, verify from the serial line or the display that the measurement has been corrected.
7. After completing the adjustments, you can enter a descriptive text string in the transmitter's memory using the **CTEXT** command, and note the adjustment date using the **CDATE** command.

Repair Maintenance

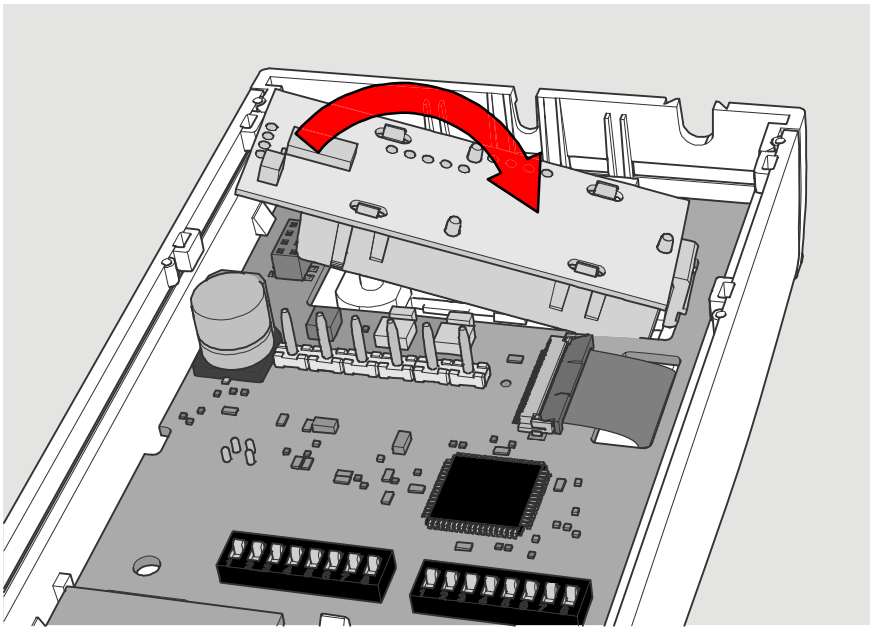
If you cannot restore the measurement accuracy of the transmitter by calibration and adjustment, you can replace the measurement modules inside the transmitter. Measurement modules are the small component boards that are connected to the main transmitter component board. See Figure 4 on page 18.

NOTE	User calibration settings (adjustment by trimmers or service port) are stored in the module. If you replace the module, you do not need to undo the previously applied correction.

Replacing the GM10 Module

To replace the module:

1. Disconnect the transmitter body from the mounting base.
2. Locate the GM10 module on the transmitter. The module is a separate component board with a golden cuvette that contains the CARBOCAP® sensor. The module is connected to the main transmitter board with a connector, and held in place by a plastic clip on the other side. See Figure 4 on page 18.
3. Disconnect the module by carefully lifting the module from the connector side. See Figure 22 below.



1311-137

Figure 22 Disconnecting the GM10 Module

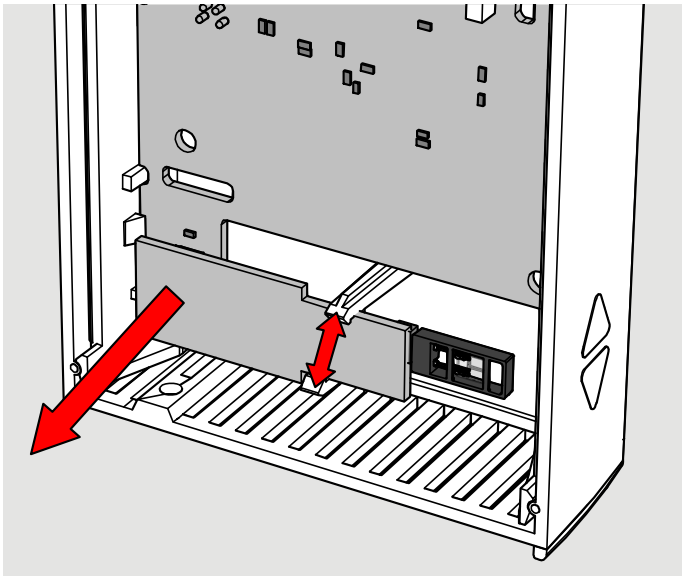
4. Take the new GM10 module and place it in the hole for the module so that the plastic clip meets the component board. Then lower the connector end of the module.
5. Push down on the module to secure the connector.
6. Reconnect the transmitter to the mounting base.
7. Verify that there are no errors when the transmitter starts up. If there are, see section Error Messages on page 66.

Replacing the HTM10 Module

CAUTION	Handle the HTM10 module carefully. When reinstalling the transmitter body to the mounting base, avoid touching the module or the HUMICAP® sensor.

To replace the module:

1. Disconnect the transmitter body from the mounting base.
2. With your fingers, push apart the two plastic holders that hold the module. Pull out the module. Keep the module straight while pulling it out, otherwise the pins may twist in the connector and damage it.



1112-028

Figure 23 Replacing the HTM10 Module

3. Take the new module and align the pins to the connector on the transmitter's component board.
4. Push down on the module so that the plastic holders clip into place. Try not to tilt the module, so that the pins will meet the connector straight on.
5. Reconnect the transmitter to the mounting base.
6. Verify that there are no errors when the transmitter starts up. If there are, see section Error Messages on page 66.

This page intentionally left blank.

CHAPTER 6
TROUBLESHOOTING

This chapter describes possible problems, their probable causes and remedies, and provides contact information for technical support.

Problem Situations

Table 11 Troubleshooting Table

Problem	Possible Cause	Remedy
Transmitter reports an error on the display or serial line.	Multiple causes.	Refer to Table 12 on page 66.
Temperature reading shown by the transmitter is too high.	Transmitter is installed in an unsuitable location, for example, near a heat source or in sunlight.	Relocate transmitter. See section Selecting Location on page 24.
	Transmitter installed in improper orientation.	Reinstall transmitter with the arrow on the mounting base pointing up.
Transmitter does not recognize a valid serial command, responds with message `FAIL 1: Unknown command`	Advanced commands not enabled.	Issue the **PASS 9000** command.
	Remote echo enabled on the transmitter, causing collisions on the RS-485 line.	Issue the **ECHO OFF** command to disable remote echo.
	Intermittent connection problem between the transmitter and your terminal.	Issue the command again.
Cannot see what you are typing on the serial line.	Serial line echo not enabled.	Enable local echo on your terminal. See section Terminal Application Settings on page 33.
Unable to complete CO_2 adjustment successfully.	Incorrect reference gas flow.	Retry calibration after reading section Calibration and Adjustment on page 55.
	Breathing on transmitter while using ambient gas as reference.	
	Measurement not stabilized before attempting adjustment.	
	Incorrect calibration gas concentration(s) used for 2-point calibration.	

Error Messages

Table 12 Error Messages

Error Text on Display	Error ID on Serial Line	Possible Cause	Remedy
HTM10 01	23	Communication problem with HTM10 module.	Check that the HTM10 module sits firmly in place. Remove and reconnect.
HTM10 04	21	Problem with humidity measurement.	- Check for missing or damaged HUMICAP® sensor on the HTM10 module. - Check for condensation on the HUMICAP® sensor. Wait for the sensor to dry out.
HTM10 03	4	Internal problem with HTM10 module.	- Restart the transmitter. - Replace the module if unable to remove the problem.
HTM10 05	22		
HMT10 06	42		
GM10 01	79	Communication problem with GM10 module.	Check that the GM10 module sits firmly in place. Remove and reconnect.
GM10 03	81	Internal problem with GM10 module.	- Restart the transmitter. - Replace the module if unable to remove the problem.
GM10 04	82		
GM10 10	28		
GM10 11	88		
GM10 12	89	Dirty or damaged GM10 module.	Replace module.
Internal 1	1	Internal problem with the transmitter.	- Restart the transmitter. - Restore the factory settings using service port or DIP switches if reset does not help.
Internal 2	2		
Internal 3	3		
Internal 4	43		

Viewing Error Messages on Serial Line

View Currently Active Errors

Use the **ERRS** command to view currently active errors on the serial line:

ERRS<cr>

Example:

```
>errs
NO ERRORS
```

View Error Table

Use the **ERRT** command to view the table of possible transmitter errors. The table includes error ID, error count since last reset, level, current state, and error text.

Critical errors require a transmitter reset to recover. Other errors may be recoverable if their cause is removed.

ERRT<cr>

Example:

```
>errt
Id:    N:     Level:State: Error text
 1:    0:  CRITICAL:OFF: FLASH memory corrupted
 2:    0:  CRITICAL:OFF: Parameter read (using defaults)
 3:    0:  CRITICAL:OFF: Parameter write
 4:    0:  CRITICAL:OFF: HTM10 03 FLASH Corrupted
21:    0:     ERROR:OFF: HTM10 04 RH measurement
22:    0:     ERROR:OFF: HTM10 05 T measurement
23:    0:     ERROR:OFF: HTM10 01 Continuous communication failure
42:    0:     ERROR:OFF: HTM10 06 Device Descriptor mismatch
43:    0:  CRITICAL:OFF: Factory parameter memory not consistent
79:    0:     ERROR:OFF: GM10 01 Continuous communication failure
81:    0:  CRITICAL:OFF: GM10 03 FLASH Corrupted
82:    0:  CRITICAL:OFF: GM10 04 MEM I
28:    0:     ERROR:OFF: GM10 10 Device Descriptor mismatch
88:    0:     ERROR:OFF: GM10 11 Module uncalibrated
89:    0:     ERROR:OFF: GM10 12 CO2 measurement
```

Reverting to Factory Settings

GMW90 series transmitters, including factory-customized transmitters, can be reverted to their original shipping configuration using the DIP switches or the service port.

Reverting the transmitter to factory settings clears all user configuration that has been done using the service port. User-made adjustments are also cleared from the GM10 and HTM10 measurement modules. The factory calibration will remain.

Reverting to Factory Settings Using DIP Switches

1. Disconnect the transmitter cover from the mounting base.
2. Make a note of the DIP switch positions before changing anything, so you can restore the positions later.
3. Set the DIP switches in the leftmost DIP switch bank as shown in Figure 24 below. Do not move the switches in the other bank.

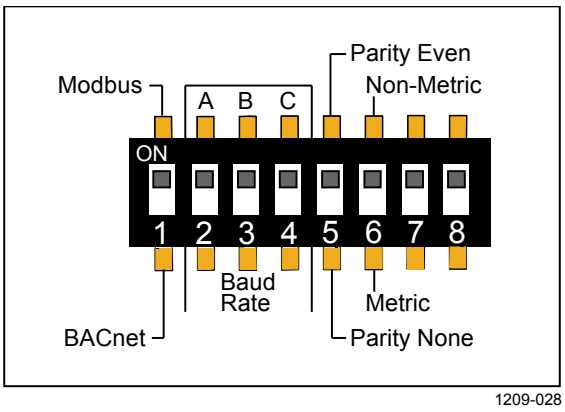


Figure 24 DIP Switches in Factory Reset Position

4. Reconnect the transmitter cover to the mounting base so it powers up. Check the screen after power-up: when the DIP switches are in factory reset position, you will see a notification text.
5. Disconnect the transmitter cover again.
6. Set the DIP switches to the positions they were before.
7. Reconnect the transmitter cover to the mounting base. Check the startup screens to verify the configuration.

Reverting to Factory Settings Using Service Port

Use the **FRESTORE** command to restore the transmitter to factory settings.

FRESTORE<cr>

NOTE	After using the **FRESTORE** command, reset the transmitter using the **RESET** command.

Example:

```
>pass 9000
>frestore
Restoring HTM10 factory parameters
HTM10 factory parameters restored
Restoring GM10 factory parameters
GM10 factory parameters restored
Restoring GMW95R factory settings
110/110 parameters restored
>reset
Resetting
GMW95R / 1.1.28.5849 / XM90
>
```

Technical Support

For technical questions, contact the Vaisala technical support by e-mail at helpdesk@vaisala.com. Provide at least the following supporting information:

- Name and model of the product in question.
- Serial number of the product.
- Name and location of the installation site.
- Name and contact information of a technically competent person who can provide further information on the problem.

Product Returns

If the product must be returned for service, see www.vaisala.com/returns. Depending on the transmitter condition, Vaisala may replace measurement modules or the entire transmitter.

For contact information of Vaisala Service Centers, see www.vaisala.com/servicecenters.

This page intentionally left blank.

CHAPTER 7
TECHNICAL DATA

This chapter provides the technical data of the GMW90 series transmitters.

Specifications

Table 13 Performance

Property	Description / Value
Carbon dioxide	
Measurement range	0 … 5000 ppm
Accuracy +20 … +30 °C (+ 68 … + 86 °F) +10 ... +20 °C, +30 ... +40 °C (+50 ... +68 °F, +86 ... +104 °F)	 ± (30 ppm + 2 % of reading) ± (35 ppm + 2.7 % of reading) ± (45 ppm + 3.8 % of reading)
Stability in typical HVAC applications	Total accuracy at room temperature ±75 ppm at 600 and 1000 ppm including 5 years drift*
Carbon dioxide sensor	Vaisala CARBOCAP® GM10
Temperature	
Measurement range	-5 ... +55 °C (+23 ... +131 ºF)
Accuracy +20 ... +30 °C (+68 ... +86 °F) +10 ... +20 °C, +30 ... +40°C (+50 ... +68 °F, +86 ... +104 °F) -5 ... +10 °C, +40...+55°C (+23 ... +50 °F, +104 ... +131 °F)	 ±0.5 °C (± 0.9 °F) ±0.6 °C (± 1.08 °F) ±0.8 °C (± 1.44 °F)
Temperature sensor	Digital temperature sensor
Relative humidity	
Measurement range	0 ... 95 %RH, non-condensing
Accuracy Temperature range +10 ... +40 °C (+50 ... +104 °F) 0 ... 60 %RH 60 ...80 %RH 80 ... 95 %RH Temperature range -5 ... +10 °C, +40 ... + 55 °C (+23 ... +50 °F, +104 ... +131°F) 0 ... 60 %RH 60 ...80 %RH 80 ... 95 %RH	 ±2.5 %RH ±3.0 %RH ±4.0 %RH ±3.5 %RH ±4.0 %RH ±5.0 %RH
Stability in typical HVAC applications	±0.5 %RH/year
Humidity sensor	Vaisala HUMICAP® 180R

*Complies with CEC-400-2008-001-CMF

Table 14 Operating Environment

Property	Description / Value
Operating temperature range	-5 ... +55 °C (+23 ... +131 °F)
Operating humidity range	0 … 95 %RH Dewpoint <30 °C (+86 °F)
Storage temperature range	-30 ... +60 °C (-22 ... +140 °F)
Electromagnetic compliance	EN61326-1, Industrial Environment

Table 15 Inputs and Outputs

Property	Description / Value
Digital Models	
Supply voltage	18 ... 35 VDC 24 VAC ±20 % 50/60 Hz
Current consumption (with 120 Ω termination)	
Average	20 mA at 24 VDC
Maximum	50 mA at 24 VDC
Power consumption	< 0.6 W
Output type	RS-485 (galvanic isolation, 1.5 kV)
RS-485 end of line termination	Enable with jumper, 120 Ω
Supported protocols	Selectable by DIP switch
BACnet MS/TP	
Operating mode	Selectable Master/Slave
Address range, master mode	0 ... 127
Address range, slave mode	128 ... 255
Modbus RTU	
Address range	0 ... 247
Service port	RS-485 line for temporary service use

Table 16 Mechanics

Property	Description / Value
IP class	IP30
Standard housing color	White (RAL9003*)
Housing material	ABS/PC, UL-V0 approved
Output connector	Screw terminals max. wire size 2 mm^2 (AWG14)
Service port connector	4-pin M8
Weight	163 g

*RAL code is only indicative with potential small variations in color shade.

Spare Parts and Accessories

Information on spare parts, accessories, and calibration products is available online at www.vaisala.com and store.vaisala.com.

Table 17 GMW90 Series Spare Parts and Accessories

Description	Order Code
Carbon dioxide measurement module	GM10SP
Temperature measurement module (for CO2+T models)	TM10SP
Humidity and temperature measurement module (CO2+T+RH models)	HTM10SP
Decorative cover set (10 pcs.)	236285
Connection cable for HM70/GM70 hand-held meter	219980
USB cable for PC connection	219690
Standard white sliding cover, blank	DRW237354SP
Standard white sliding cover with hole for display	DRW237339SP

Dimensions in mm

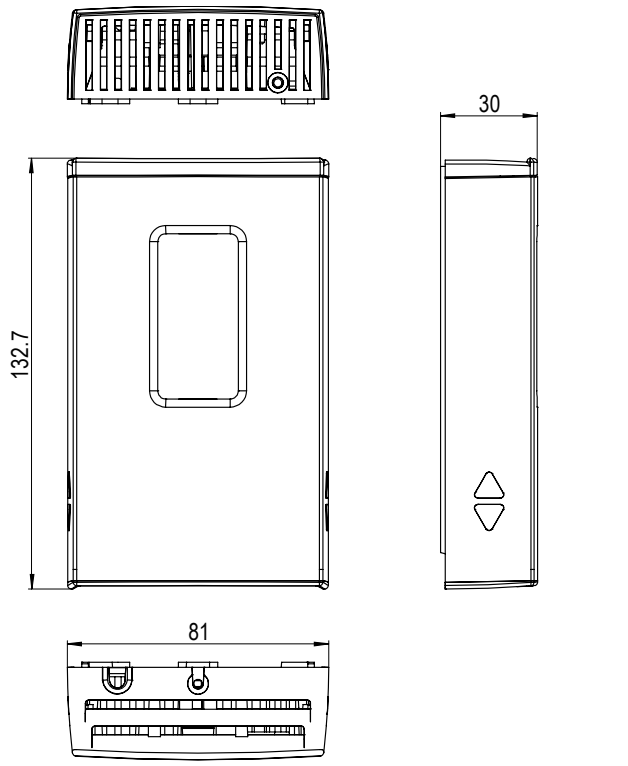


Figure 25 GMW90 Series Dimensions

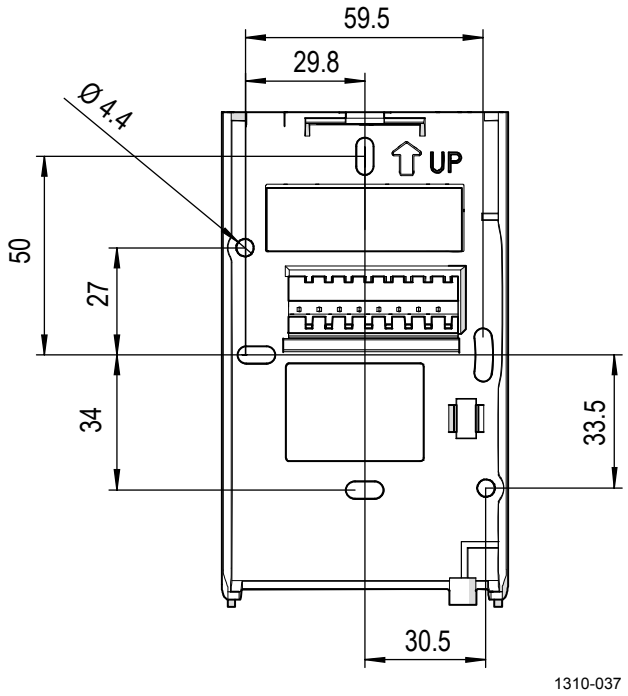


Figure 26 Dimensions of the Mounting Base

APPENDIX A

BACNET REFERENCE

This appendix describes the BACnet protocol implementation of the GMW90 series digital transmitters.

BACnet Protocol Implementation Conformance Statement

This statement is a part of the BACnet standard and is required for its use.

Vendor Name:	Vaisala Oyj
Product Name:	XMW90
Product Model Numbers:	GMW95 | GMW95R
Applications Software Version:	1.1.0 and later
Firmware Version:	1.1.0.0 and later
BACnet Protocol Revision:	Version 1, Revision 4
BACnet Standardized Device Profile (Annex L):	☐ BACnet Operator Workstation (B-OWS) ☐ BACnet Building Controller (B-BC) ☐ BACnet Advanced Application Controller (B-AAC) ☐ BACnet Application Specific Controller (B-ASC) ☑ BACnet Smart Sensor (B-SS) ☐ BACnet Smart Actuator (B-SA)
List of all BACnet Interoperability Building Blocks Supported (Annex K): See also section BIBBs Supported on page 86.	DS-RP-B, DS-RPM-B, DS-WP-B, DS-COVU-A, DM-DDB-B, DM-DOB-B, DM-DCC-B, DM-RD-B
Segmentation Capability	☐ Segmentation Requests Supported ☐ Segmentation Responses Supported

Standard Object Types Supported	☑ Analog Input ☐ Analog Output ☑ Analog Value ☐ Averaging ☐ Binary Input ☐ Binary Output ☐ Binary Value ☐ Calendar ☐ Command ☑ Device ☐ Event Enrollment ☐ File ☐ Group ☐ Life Safety Point ☐ Life Safety Zone ☐ Loop ☐ Multistate Input ☐ Multistate Output ☐ Multistate Value ☐ Notification Class ☐ Program ☐ Schedule ☐ Trend Log
Data Link Layer Options	☐ BACnet Internet Protocol (IP) (Annex J) ☐ BACnet IP (Annex J), Foreign Device ☐ ISO 88023, Ethernet (Clause 7) ☐ ANSI/ATA 878.1, 2.5 MB ARCNET® network (Clause 8) ☐ ANSI/ATA 878.1, RS485 ARCNET network (Clause 8), baud rates: _____ ☑ Master-Slave/Token-Passing (MS/TP) master (Clause 9), baud rates: 9600, 19200, 38400, 57600, 76800, 115200 ☑ MS/TP slave (Clause 9), baud rates: 9600, 19200, 38400, 57600, 76800, 115200 ☐ Point-To-Point, EIA 232 (Clause 10), baud rates: _____ ☐ Point-To-Point, modem (Clause 10), baud rates: _____ ☐ LonTalk® protocol (Clause 11), medium: _____ ☐ Other:

Device Address Binding Is static device binding supported? (required for two-way communication between MS/TP slaves and other devices)	☐ Yes ☑ No
Networking Options	☐ Router, Clause 6: ☐ Annex H, BACnet Tunneling Router over IP ☐ BACnet/IP Broadcast Management Device (BBMD)
Does the BBMD support registrations by Foreign Devices?	☐ Yes
	☐ No
Character Sets Supported	☑ UTF-8 / ANSI X3.4 ☐ IBM®/Microsoft® DoubleByte Character Set (DBCS) ☐ ISO 8859-1 ☐ ISO 10646 Universal Character Set-2 (UCS2) ☐ ISO 10646 (UCS-4) ☐ Japanese Industrial Standard (JIS) C 6226
Types of non-BACnet equipment /network(s) supported:	None

Transmitter Models and Objects

The availability of BACnet objects depends on the transmitter model. The following objects are present on all GMW90 series models:

- Device object
- Carbon dioxide object
- Temperature object

The following additional objects are present on models that include relative humidity measurement (for example, GMW95R):

- Relative humidity object
- Calculated humidity objects
- Operation pressure object
- Operation altitude object

Device Object

Note the following:

- Writable means writable via BACnet
- **Max_Master** and **Max_Info_Frames** are required in a Master device.
- **UV** = Configured at Vaisala factory to a unique value. See additional information after the table.

Table 18 Device Object Properties

Property	Data type (Application Type)	Writable (Conformance Code)	Value or Initial Value	Persistence
Object_Identifier	BACnetObjectIdentifier	Y (R)	02 00 00 00 (hex) Object Type = 8, Instance = xxxxxxx **UV**	Nonvolatile
Object_Name	CharacterString[50]	Y (R)	"XMW90_Yxxxxxxx" **UV**	Nonvolatile
Object_Type	BACnetObjectType (ENUMERATED)	N (R)	8 (Device Object)	Fixed
System_Status	BACnetDeviceStatus (ENUMERATED)	N (R)	0 (Operational)	Volatile
Vendor_Name	Character String	N (R)	"Vaisala Oyj"	Fixed
Vendor_Identifier	Unsigned16	N (R)	339	Fixed
Model_Name	CharacterString	N (R)	Product model. For example, “GMW95”	Nonvolatile
Firmware_Revision	CharacterString	N (R)	X.X.X.X (BACnet interface)	Fixed
Application_Software_Revision	CharacterString	N (R)	X.X.X.X	Fixed
Location	Character String[50]	Y (O)	“Location”	Nonvolatile
Description	Character String[50]	Y (O)	“Description”	Nonvolatile
Protocol_Version	Unsigned	N (R)	1	Fixed
Protocol_Revision	Unsigned	N (R)	4	Fixed
Protocol_Services	BACnetProtocolServices Supported (BIT STRING)	N (R)	Read Property Read Property Multiple Write Property Device Communication Control Reinitialize Device Who-Is Who-Has	Fixed
Protocol_Object_Types_Supported	BACnetObjectTypesSupported (BIT STRING)	N (R)	Analog Input Analog Value Device	Fixed
Object_List	BACnetARRAY[N]of BACnetObjectIdentifier	N (R)	Device Object AI1 (Carbon Dioxide) AI2 (Relative Humidity) AI3 (Temperature) AI4 (Dewpoint) AI5 (Dewpoint (Tdf)) AI6 (Dewpoint depression) AI7 (Wet bulb temperature) AI8 (Absolute humidity) AI9 (Mixing ratio) AI10 (Enthalpy) AV1 (Pressure) AV2 (Altitude)	Fixed

Property	Data type (Application Type)	Writable (Conformance Code)	Value or Initial Value	Persistence
Max_APDU_Length_Accepted	Unsigned16	N (R)	244	Fixed
Max_Master	Unsigned16 (1..127)	Y (R/O)	127	Nonvolatile
Max_Info_Frames	Unsigned	N (R/O)	1	Fixed
Segmentation_Supported	BACnetSegmentation (ENUMERATED)	N (R)	3 (No segmentation)	Fixed
APDU_Timeout	Unsigned	N (R)	3000 (ms)	Fixed
APDU_Retries	Unsigned	N (R)	0	Fixed
Device_Address_Binding	List of BACnetAddressBinding	N (R)	NULL	Fixed
Database_Revision	Unsigned	N (R)	0	Volatile

Object_Identifier: Must be unique in BACnet network. As Object Identifier is 22 bits long its value range is 0 ... 4194303. Each device is assigned a random value in this range at Vaisala factory.

Object_Name: Must be unique in BACnet network. Default object name contains the name and serial number of the device. For example, transmitter model GMW95 with serial number G1234567 receives the default object name "GMW95_G1234567".

System_Status: System status can be OPERATIONAL (0) or NON-OPERATIONAL (4). Device goes to NON-OPERATIONAL state in case of fatal error.

Protocol_Services: Who-Is, I-Am, Who-Has, I-Have and UnconfirmedCOVNotification services are available only when XMW90 is MS/TP master. Reinitialize Device service must be password protected. According to BACnet protocol, password is character string having max 20 characters. Default password is "1234". Password can be changed through the service port by using the **BACNET** command. See section Set BACnet Parameters on page 53.

Database_revision: This is changed during operation according to section 12.11.35 of ANSI/ASHRAE standard 135-2008.

Carbon Dioxide Object

Table 19 Carbon Dioxide Object Properties

Property	Data type (Application Type)	Writable (Conformance Code)	Value or Initial Value	Persistence
Object_Identifier	BACnetObjectIdentifier	No (R)	00 00 00 01 (hex) Object Type = 0, Instance = 1	Nonvolatile
Object_Name	CharacterString	No (R)	"CO2"	Nonvolatile
Object_Type	BACnetObjectType (ENUMERATED)	No (R)	0 (Analog Input)	Fixed
Present_Value	Real	Yes (When Oos) (R)	0.0	Volatile
Description	CharacterString	No (O)	"Carbon Dioxide"	Nonvolatile
Units	BACnetEngineeringUnits (ENUMERATED)	No (R)	96 (parts-per-million)	Nonvolatile
Status_Flags	BACnet Status Flags (BIT STRING)	Yes (when OoS) (R)	0 (FAULT == FALSE)	Volatile
Reliability	BACnet Reliability (ENUMERATED)	Yes (when OoS) (O)	0 (NO FAULT DETECTED)	Volatile
Event State	BACnetEventState (ENUMERATED)	No (R)	0 (NORMAL)	Volatile
Out_of_Service	BOOLEAN	Yes (R)	0 (FALSE)	Volatile
COV_Increment	Real	Yes (O)	NaN (COV reporting disabled)	Nonvolatile
Min_Pres_Value	Real	No (O)	0.0 (same as limit for UNDER_RANGE)	Nonvolatile
Max_Pres_Value	Real	No (O)	2400 (same as limit for OVER_RANGE)	Nonvolatile

Table 20 Status Flags

Flag	State	Cause
IN_ALARM	FALSE	Event State equals 0 (NORMAL)
	TRUE	Event State not 0
FAULT	FALSE	Reliability equals 0 (NO FAULT DETECTED)
	TRUE	Reliability not 0
OVERRIDDEN	FALSE	Always FALSE
OUT_OF_SERVICE	FALSE	Present Value may NOT be written via BACnet
	TRUE	Present Value may be written via BACnet[1)]

Table 21 Reliability

State	Cause
0 NO_FAULT_DETECTED	
1 NO_SENSOR	No contact to measurement module
2 OVER_RANGE	CO2 level over BAC_CO2_MAX_VALUE
3 UNDER_RANGE	CO2 level under BAC_CO2_MIN_VALUE
7 UNRELIABLE_OTHER	Other measurement error

Table 22 Event State

State	Cause
0 NORMAL	Reliability equals 0 (NO FAULT DETECTED)
1 FAULT	Reliability not 0

Temperature Object

Table 23 Temperature Object Properties

Property	Data type (Application Type)	Writable (Conformance Code)	Value or Initial Value	Persistence
Object_Identifier	BACnetObjectIdentifier	No (R)	00 00 00 03 (hex) Object Type = 0, Instance = 3	Nonvolatile
Object_Name	CharacterString	No (R)	"T"	Nonvolatile
Object_Type	BACnetObjectType (ENUMERATED)	No (R)	0 (Analog Input)	Fixed
Present_Value	Real	Yes (When Oos) (R)	0.0	Volatile
Description	CharacterString	No (O)	"Temperature"	Nonvolatile
Units	BACnetEngineeringUnits (ENUMERATED)	Yes (R)	62 (degrees-Celsius) Possible units are C (62) or F (64).	Nonvolatile
Status_Flags	BACnet Status Flags (BIT STRING)	Yes (when OoS) (R)	0 (FAULT == FALSE)	Volatile
Reliability	BACnet Reliability (ENUMERATED)	Yes (when OoS) (O)	0 (NO FAULT DETECTED)	Volatile
Event State	BACnetEventState (ENUMERATED)	No (R)	0 (NORMAL)	Volatile
Out_of_Service	BOOLEAN	Yes (R)	0 (FALSE)	Volatile
COV_Increment	Real	Yes (O)	NaN (COV reporting disabled)	Nonvolatile
Min_Pres_Value	Real	No (O)	-40.0 (same as limit for UNDER_RANGE)	Nonvolatile
Max_Pres_Value	Real	No (O)	+80.0 (same as limit for OVER_RANGE)	Nonvolatile

Table 24 Status Flags

Flag	State	Cause
IN_ALARM	FALSE	Event State equals 0 (NORMAL)
	TRUE	Event State not 0
FAULT	FALSE	Reliability equals 0 (NO FAULT DETECTED)
	TRUE	Reliability not 0
OVERRIDDEN	FALSE	Always FALSE
OUT_OF_SERVICE	FALSE	Present Value may NOT be written via BACnet
	TRUE	Present Value may be written via BACnet

Table 25 Reliability

State	Cause
0 NO_FAULT_DETECTED	
1 NO_SENSOR	No contact to measurement module
2 OVER_RANGE	T over +80 °C
3 UNDER_RANGE	T under -40 °C
7 UNRELIABLE_OTHER	Other measurement error

Table 26 Event State

State	Cause
0 NORMAL	Reliability equals 0 (NO FAULT DETECTED)
1 FAULT	Reliability not 0

Relative Humidity Object

Table 27 Relative Humidity Object Properties

Property	Data type (Application Type)	Writable (Conformance Code)	Value or Initial Value	Persistence
Object_Identifier	BACnetObjectIdentifier	No (R)	00 00 00 02 (hex) Object Type = 0, Instance = 2	Nonvolatile
Object_Name	CharacterString	No (R)	"RH"	Nonvolatile
Object_Type	BACnetObjectType (ENUMERATED)	No (R)	0 (Analog Input)	Fixed
Present_Value	Real	Yes (When Oos) (R)	0.0	Volatile
Description	CharacterString	No (O)	"Relative Humidity"	Nonvolatile
Units	BACnetEngineeringUnits (ENUMERATED)	No (R)	29 (percent-relative-humidity)	Nonvolatile
Status_Flags	BACnet Status Flags (BIT STRING)	Yes (when OoS) (R)	0 (FAULT == FALSE)	Volatile
Reliability	BACnet Reliability (ENUMERATED)	Yes (when OoS) (O)	0 (NO FAULT DETECTED)	Volatile
Event State	BACnetEventState (ENUMERATED)	No (R)	0 (NORMAL)	Volatile
Out_of_Service	BOOLEAN	Yes (R)	0 (FALSE).	Volatile
COV_Increment	Real	Yes (O)	NaN (COV reporting disabled)	Nonvolatile
Min_Pres_Value	Real	No (O)	0.0 (same as limit for UNDER_RANGE)	Nonvolatile
Max_Pres_Value	Real	No (O)	100 (same as limit for OVER_RANGE)	Nonvolatile

Table 28 Status Flags

Flag	State	Cause
IN_ALARM	FALSE	Event State equals 0 (NORMAL)
	TRUE	Event State not 0
FAULT	FALSE	Reliability equals 0 (NO FAULT DETECTED)
	TRUE	Reliability not 0
OVERRIDDEN	FALSE	Always FALSE
OUT_OF_SERVICE	FALSE	Present Value may NOT be written via BACnet
	TRUE	Present Value may be written via BACnet

Table 29 Reliability

State	Cause
0 NO_FAULT_DETECTED	
1 NO_SENSOR	No contact to measurement module
2 OVER_RANGE	RH over 100%
3 UNDER_RANGE	RH under 0%
7 UNRELIABLE_OTHER	Other measurement error

Table 30 Event State

State	Cause
0 NORMAL	Reliability equals 0 (NO FAULT DETECTED)
1 FAULT	Reliability not 0

Calculated Humidity Objects

Table 31 Calculated Humidity Objects

Instance	Name	Description	Unit
4	"Td"	"Dewpoint"	62/64 (ºC/ ºF)
5	"Tdf"	"Dewpoint"	62/64 (ºC/ ºF)
6	"dTd"	"Dewpoint depression"	121/120 (ΔºK/ ΔºF)
7	"Tw"	"Wet bulb temperature"	62/64 (ºC/ ºF)
8	"a"	"Absolute humidity"	217/2000 grams-per-cubic-meter / grains-per-cubic-foot (Vaisala defined unit)
9	"x"	"Mixing ratio"	28/2001 grams-of-water-per-kilogram-dry-air / grains-of-water-per-pound (Vaisala defined unit)
10	"h"	"Enthalpy"	149/24 kilojoules-per-kilogram-dry-air / btus-per-pound-of-dry-air

Table 32 Calculated Humidity Object Properties

Property	Data type (Application Type)	Writable (Conformance Code)	Value or Initial Value	Persistence
Object_Identifier	BACnetObjectIdentifier	No (R)	00 00 00 xx (hex) Object Type = 0, Instance = x See Table 31 above.	Nonvolatile
Object_Name	CharacterString	No (R)	See Table 31 above.	Nonvolatile
Object_Type	BACnetObjectType (ENUMERATED)	No (R)	0 (Analog Input)	Fixed
Present_Value	Real	Yes (When Oos) (R)	0.0	Volatile
Description	CharacterString	No (O)	See table above	Nonvolatile
Units	BACnetEngineeringUnits (ENUMERATED)	No (R)	See table above	Nonvolatile
Status_Flags	BACnet Status Flags (BIT STRING)	Yes (when OoS) (R)	0 (FAULT == FALSE)	Volatile
Reliability	BACnet Reliability (ENUMERATED)	Yes (when OoS) (O)	0 (NO FAULT DETECTED)	Volatile
Event State	BACnetEventState (ENUMERATED)	No (R)	0 (NORMAL)	Volatile
Out_of_Service	BOOLEAN	Yes (R)	0 (FALSE)	Volatile
COV_Increment	Real	Yes (O)	NaN (COV reporting disabled)	Nonvolatile

Table 33 Status Flags

Flag	State	Cause
IN_ALARM	FALSE	Event State equals 0 (NORMAL)
	TRUE	Event State not 0
FAULT	FALSE	Reliability equals 0 (NO FAULT DETECTED)
	TRUE	Reliability not 0
OVERRIDDEN	FALSE	Always FALSE
OUT_OF_SERVICE	FALSE	Present Value may NOT be written via BACnet
	TRUE	Present Value may be written via BACnet

Table 34 Reliability

State	Cause
0 NO_FAULT_DETECTED	
1 NO_SENSOR	No contact to measurement module
2 OVER_RANGE	RH over 100%
3 UNDER_RANGE	RH under 0%
7 UNRELIABLE_OTHER	Other measurement error

Table 35 Event State

State	Cause
0 NORMAL	Reliability equals 0 (NO FAULT DETECTED)
1 FAULT	Reliability not 0

Operation Pressure Object

Set current atmospheric pressure to improve the calculation accuracy of pressure dependent humidity parameters.

NOTE Pressure and Altitude objects are linked together. If Present Value in one object is changed, Present Value in another object is changed accordingly.

Table 36 Operation Pressure Object Properties

Property	Data type	Writable	Value or Initial Value
Object Identifier	BACnet Object Identifier	No	00 80 00 01 (hex) Object Type = 2, Instance = 1
Object Name	Character String	No	"OPER P"
Object Type	BACnet Object Type	No	2 (Analog Value)
Present Value	Real	Yes	1013.25
Description	Character String	No	"Operation Pressure"
Units	BACnet Engineering Units	No	133 (hectopascals)
Status Flags	BACnet Status Flags	No	0 (FAULT == FALSE)
Event State	BACnet Event State	No	0 (NORMAL, does not change)
Out of Service	BOOLEAN	No	0 (FALSE)

Table 37 Status Flags

Flag	State	Cause
IN_ALARM	FALSE	Always FALSE
FAULT	FALSE	Always FALSE
OVERRIDDEN	FALSE	Always FALSE
OUT_OF_SERVICE	FALSE	Always FALSE

Operation Altitude Object

Set current atmospheric pressure to improve the calculation accuracy of pressure dependant humidity parameters.

NOTE Pressure and Altitude objects are linked together. If Present Value in one object is changed, Present Value in another object is changed accordingly.

Table 38 Operation Altitude Object Parameters

Property	Data type	Writable	Value or Initial Value
Object Identifier	BACnet Object Identifier	No	00 80 00 02 (hex) Object Type = 2, Instance = 2
Object Name	Character String	No	"OPER Altitude"
Object Type	BACnet Object Type	No	2 (Analog Value)
Present Value	Real	Yes	0.0
Description	Character String	No	"Operating Altitude"
Units	BACnet Engineering Units	Yes	31 (meters) or 33 (feet)
Status Flags	BACnet Status Flags	No	0 (FAULT == FALSE)
Event State	BACnet Event State	No	0 (NORMAL, does not change)
Out of Service	BOOLEAN	No	0 (FALSE)

Table 39 Status Flags

Flag	State	Cause
IN_ALARM	FALSE	Always FALSE
FAULT	FALSE	Always FALSE
OVERRIDDEN	FALSE	Always FALSE
OUT_OF_SERVICE	FALSE	Always FALSE

BIBBs Supported

Table 40 below lists all the BIBBs which, per ANSI/ASHRAE Standard 135-2008, could be supported by a BACnet Smart Sensor (B-ASC). The checked BIBBs are supported by the device.

Table 40 BACnet Smart Sensor BIBBs Support

Application Service (B-SS)	Designation	Supported
Data Sharing - Read Property - A	DS-RP-A	☐
Data Sharing - Read Property - B	DS-RP-B	☑
Data Sharing - Read Property Multiple - A	DS-RPM-A	☐
Data Sharing - Read Property Multiple - B	DS-RPM-B	☑
Data Sharing - Write Property - A	DS-WP-A	☐
Data Sharing - Write Property - B	DS-WP-B	☑
Data Sharing - Write Property Multiple - B	DS-WPM-B	☐
Data Sharing - COV - Unsolicited - A	DS-COVU-A	☑
Data Sharing - COV - Unsolicited - B	DS-COVU-B	☐
Alarm and Event - Notification Internal - B	AE-N-I-B	☐
Alarm and Event - ACK - B	AE-ACK-B	☐
Alarm and Event - Information - B	AE-INFO-B	☐
Alarm and Event - Enrollment Summary - B	AE-ESUM-B	☐
Scheduling - External - B	SCHED-E-B	☐
Trending - Viewing and Modifying Trends Internal - B	T-VMT-I-B	☐
Trending - Automated Trend Retrieval - B	T-ATR-B	☐
Device Management - Dynamic Device Binding - A	DM-DDB-A	☐
Device Management - Dynamic Device Binding - B	DM-DDB-B	☑
Device Management - Dynamic Object Binding - A	DM-DOB-A	☐
Device Management - Dynamic Object Binding - B	DM-DOB-B	☑
Device Management - Device Communication Control - B	DM-DCC-B	☑
Device Management - Time Synchronization - B	DM-TS-B	☐
Device Management - UTC Time Synchronization - B	DM-UTC-B	☐
Device Management - Reinitialize Device - B	DM-RD-B	☑
Device Management - Backup and Restore - B	DM-BR-B	☐
Network Management - Connection Establishment - A	NM-CE-A	☐

Application Services Supported

Table 41 below lists all the BACnet standard application services. The checked services are supported by the device.

Table 41 BACnet Standard Application Services Support

Application Service	Initiates Requests	Executes Requests
AcknowledgeAlarm	☐	☐
AddListElement	☐	☐
AtomicReadFile	☐	☐
AtomicWriteFile	☐	☐
ConfirmedCOVNotification	☐	☐
ConfirmedEventNotification	☐	☐
ConfirmedPrivateTransfer	☐	☐
ConfirmedTextMessage	☐	☐
CreateObject	☐	☐
DeleteObject	☐	☐
DeviceCommunicationControl	☐	☑
Disconnect-Connection-To-Network	☐	☐
Establish-Connection-To-Network	☐	☐
GetAlarmSummary	☐	☐
GetEnrollmentSummary	☐	☐
GetEventInformation	☐	☐
I-Am	☑	☐
I-Am-Router-To-Network	☐	☐
I-Could-Be-Router-To-Network	☐	☐
I-Have	☑	☐
Initialize-Routing-Table	☐	☐
Initialize-Routing-Table-Ack	☐	☐
LifeSafetyOperation	☐	☐
ReadProperty	☐	☑
ReadPropertyConditional	☐	☐
ReadPropertyMultiple	☐	☑
ReadRange	☐	☐
ReinitializeDevice	☐	☑
RemoveListElement	☐	☐
SubscribeCOV	☐	☐
SubscribeCOVProperty	☐	☐
TimeSynchronization	☐	☐
UnconfirmedCOVNotification	☑	☐
UnconfirmedEventNotification	☐	☐
UnconfirmedPrivateTransfer	☐	☐
UnconfirmedTextMessage	☐	☐
UTCTimeSynchronization	☐	☐
VT-Close	☐	☐
VT-Data	☐	☐
VT-Open	☐	☐
Who-Has	☐	☑
Who-Is	☐	☑
Who-Is-Router-To-Network	☐	☐
WriteProperty	☐	☑
WritePropertyMultiple	☐	☐

This page intentionally left blank.

APPENDIX B
MODBUS REFERENCE

This appendix describes the Modbus protocol implementation of the GMW90 series digital transmitters.

Table 42 Modbus Functions Supported by GMW90

Function Code	Name
03 (0x03)	Read Holding Registers
04 (0x04)	Read Input Register
06 (0x06)	Write Single Register
16 (0x10)	Write Multiple Registers
43 / 14 (0x2B / 0x0E)	Read Device Identification

Table 43 GMW90 Modbus Measurement Data Registers

Name	Metric float	Metric integer	Metric unit	Non-metric float	Non-metric integer	Non-metric unit
CO2	0001…0002	0257 (×1)	ppm	6401…6402	6657 (×1)	ppm
RH	0003…0004	0258 (×0.01)	%RH	6403…0004	6458 (×0.01)	%RH
T	0005…0006	0259 (×0.01)	°C	6405…0006	6459 (×0.01)	°F
Td	0007…0008	0260 (×0.01)	°C	6407…0008	6460 (×0.01)	°F
Tdf	0009…0010	0261 (×0.01)	°C	6409…0010	6461 (×0.01)	°F
dTd	0011…0012	0262 (×0.01)	°C	6411…0012	6462 (×0.01)	°F
Tw	0013…0014	0263 (×0.01)	°C	6413…0014	6463 (×0.01)	°F
a	0015…0016	0264 (×0.01)	g/m3	6415…0016	6464 (×0.01)	gr/ft3
x	0017…0018	0265 (×0.01)	g/kg	6417…0018	6465 (×0.01)	gr/lb
h	0019…0020	0266 (×0.01)	kJ/kg	6419…0020	6466 (×0.01)	btu/lb

Values read from the integer registers must be multiplied with the provided multiplier to get the actual value. All integer values are signed.

Available measurements depend on the transmitter model. Values may be unavailable also in case of device failure. Read status registers or exception status outputs to check for failures. Accessing unavailable (unsupported or temporarily missing) measurement data does not generate an exception. “Unavailable” value (a quiet NaN for floating point data or 0x8000 for integer data) is returned instead. An exception is generated only for any access outside the GMW90 registers.

A “quiet NaN” value is returned for unavailable values. Writing any NaN or infinite value is silently ignored.

NOTE A complete 32-bit floating point value should be read and written in a single Modbus transaction.

Table 44 GMW90 Modbus Status Registers (Read-only)

Name	Address	Description
Error code (bits 15…0)	0513,6913	0 = no errors

Table 45 GMW90 Modbus Error Code Bits

Bit	Description
0	Any critical error is active. Requires transmitter restart or maintenance.
1	Any error is active. May be recoverable.
2	Internal error (Flash)
3	Module communication or compatibility error
4	HTM10 module error
5	Temperature measurement error
6	Humidity measurement error
7	GM10 module error
8	CO2 measurement error
9	Miscellaneous error

Table 46 GMW90 Modbus Configuration Parameter Registers

Name	Metric float	Metric integer	Metric unit & valid range	Non-metric float	Non-metric integer	Non-metric unit & valid range
Pressure	0777…0779	1029 (×1)	700…1100 hPa	7177…7179	7429 (×1)	700 … 1100 hPa
Elevation	0779…0780	1030 (×1)	-700...2300 m	7179…7180	7430 (×1)	-2300 … 10000 ft

NOTE

Elevation is linked to pressure according to the following equation:

$p = 101325\ (1 - 2.25577\ 10^{-5}\ h)^{5.25588}$

where p is pressure in Pa and h is altitude above sea level in m. This means that changing altitude will also change pressure and vice versa.

Table 47 GMW90 Modbus Device Identification

Object Id	Object Name	Description
0x00	VendorName	“Vaisala”
0x01	ProductCode	Transmitter model (for example, “GMW95”)
0x02	MajorMinorVersion	Software version (for example, “1.0.0”)
0x03	VendorUrl	“http://www.vaisala.com/”
0x04	ProductName	GMW90
0x80	SerialNumber	Serial number (e.g. “H0710040”)
0x81	CalibrationDate	Date of the last calibration (for example, “2012-08-07”, empty if not available)
0x82	CalibrationText	Information text of the last calibration (empty if not available)

Table 48 GMW90 Modbus Exception Responses

Code	Name	Reason
01	ILLEGAL FUNCTION	Unsupported function code
02	ILLEGAL DATA ADDRESS	Address out of valid ranges
03	ILLEGAL DATA VALUE	Otherwise invalid request

www.vaisala.com

M211659EN